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The
Geographical Journal.

No. 5. NOVEMBER, 1907. Vol. XXX.

ON NORTH POLAR PROBLEMS.*

By Dr. FRIDTJOF NANSEN.

A year and a half ago our late distinguished President, Sir Clements Markham, read before our Research Department a most interesting paper,† treating more or less of the same subject which I am going to discuss to-night; and the paper was followed by an important discussion. To my great regret, I was unable to be present on that occasion. Although it might seem unnecessary to take up this subject so soon again for fresh consideration, I have nevertheless been asked to do so, evidently because a full discussion of this matter is considered to be important for the future exploration of the still Unknown North. Perhaps it was also hoped that I might be able to throw some new light upon the many difficult questions. Although I fear that I shall not be able to justify such bold expectations, I thought I could not refuse the kind request, considering that I have given some part of my life to the study of these questions; and I am glad to use this opportunity to sum up some of the conclusions to which my researches have led me.

The present paper was originally intended to deal with both North Polar and South Polar problems; but I soon saw that if the discussion should be in any way satisfactory, it would be necessary for the present to limit ourselves only to the North Polar problems, following the maxim which I think ought to be the maxim of all polar exploration of the future: do not try to do too much, but that which you do, try to do it thoroughly well. I cannot, therefore, even promise to take up for consideration here to-night all North Polar problems; I shall have to limit myself to those which I consider to be of most importance.

* Read at the Royal Geographical Society, April 29, 1907. Map, p. 584.

† Clements Markham, "On the Next Great Arctic Discovery," *Geographical Journal*, vol. 27, 1906, p. 1.

On many and essential points I fully agree with the views set forth by my venerated friend Sir Clements Markham in the above-mentioned paper, whilst on others we differ somewhat. Many of his conclusions have been based on the discoveries of the *Fram* Expedition across the North Polar basin, and on the descriptions and discussions of our observations given in some of my scientific memoirs.* I am, however, sorry to have to admit that investigations which I have carried on after those memoirs were written, have compelled me to alter, or at least to modify, some of the views set forth in those volumes, and to-night I shall therefore to some extent have the somewhat ungrateful task of trying to pull down again some parts of my own building.

I think we shall do well by dividing the subject before us in two parts:—

1. First, we ought to find out what the problems of the Unknown North really are, and which of them are important.

2. Secondly, we have to examine which methods of exploration are best for a successful solution of these problems, and what kind of observations are especially desirable.

The Problems of the Unknown North.

Many of the most important problems of the North Polar regions have been more or less solved by the various expeditions of late years. The northward extension of Greenland and its islands has been settled by Peary, new northern lands of the American Arctic archipelago have been explored by Sverdrup, the northward and westward extension of the Franz Josef archipelago has been settled by the *Fram* Expedition, by Jackson, and by the Duke of the Abruzzi; the small extension of Bennett island was discovered by Baron Toll. There is, in fact, no known land in the north whose northern coasts are not now explored. And, moreover, perhaps the most important feature of North Polar geography, viz. the deep North Polar basin extending eastwards north of Spitsbergen, Franz Josef Land, and the New Siberian islands, has been discovered by the *Fram* Expedition, and the great features of its currents and oceanography have been explored. The eastern shallow part of this sea, north of eastern Siberia, was traversed by the *Jeannette*. During his recent expedition through the North-West Passage Amundsen has explored the magnetic north pole, and many important problems of that interesting region will probably be solved when his magnificent material of observations has been worked up. It may also be pointed out that the Greenland inland ice, which is a very important feature of Arctic geography, has been crossed, and its northern extension has been settled by Peary.

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* See especially, *The Norwegian North Polar Expedition*, 1893–96. *Scientific Results*, vol. 3, No. 9, and vol. 4, No. 13.

I think, therefore, that we have reason to look back with satisfaction upon the progress which the geography of the North Polar regions has made during the end of last century and the beginning of this. Hardly in any previous period of the same short duration has the knowledge of the Arctic Regions made similar important advances. But certainly we cannot stop here; there are still many problems of great interest waiting for their solution in the north. I shall try to mention some of them which I think can be solved without very great difficulty.

In order to get an idea of the chief problems of the still Unknown North, we have naturally to follow the ordinary process of reasoning from the known to the unknown, and we have, first of all, to ask ourselves the question: What do the known geographical, geomorphological, and geological features of the surrounding known regions tell us about the still unknown area near the north pole?

The discovery by the *Fram* Expedition of a deep north polar basin, with depths exceeding 2000 fathoms, is very important in this respect. Sir Clements Markham even says, that "it drew the veil from the Arctic mystery and made all things clear." This deep North Polar basin forms the northern termination of a series of oceanic depressions, extending northwards through the Norwegian sea, from the eastern side of the Atlantic ocean, and dividing the continental masses of the old and the new world. These depressions, following to some extent the direction of the meridian, form evidently a more or less continuous tract where, during some remote geological period, the Earth's crust has sunk in owing to certain causes which are, however, difficult to explain, and we shall not discuss here the various theories attempted. The different basins of these depressions are separated by transverse submarine ridges, *e.g.* the Scotland-Færoe-Iceland-Greenland ridge, the Jan Mayen ridge, extending from Jan Mayen towards Bear island, and also a ridge extending north-west from Spitsbergen probably towards northern Greenland. We know that the depression of the North Polar basin extends from the latter ridge continuously towards the north-east and east as far as north of the New Siberian islands, but how much further eastwards is unknown, and so is also the width of the basin towards the north. Its measured depths vary between 1800 and 2100 fathoms.

The sinking in of the Earth's crust during the formation of such a deep and probably extensive basin is always accompanied by considerable volcanic disturbances along the edges of the sinking area. For instance, the Pacific ocean forms a great area of depression where, in several places, sinking of the sea-bottom is evidently going on at present, and it is not long ago that the citizens of San Francisco and Lima felt the disastrous effects of this process. By the eruptions of lava and basalts, connected with such changes in the Earth's crust,

permanent traces are left to posterity by which the geological age of the changes can be determined.

The edge of the North Polar basin is but little known. As far as our knowledge goes, there are no very modern volcanic formations in these regions. The whole of Franz Josef Land, and some part of eastern Spitsbergen and King Charles Land, are to a great extent formed by basalts from the later part of the Jurassic period, and perhaps early Cretaceous, but there are hardly any much later basalts. This might indicate that at least some sinking of the sea-bottom to the north has occurred during the later part of the Jurassic age and the early Cretaceous; but the first formation of the North Polar basin may have taken place long before that time.

On Bennett island the *Jeannette* Expedition found, according to De Long's diary, volcanic rocks and lava, which perhaps means basalt, but their geological age is unfortunately unknown. The sad disappearance of Baron Toll, who visited the island some years ago, has prevented us from ever knowing what this distinguished explorer and geologist had found out as to the geology of this island, which he discovered to have a very small extension.

The basalts known on the west coast of Greenland, in the region of Disco island and further north, and those on its north-eastern coast, in the region of the Scoresby fjord and north of it, are from a much later period, chiefly the Tertiary, and seem to belong to the period of eruptions represented by the basalts of Scotland and the Færoes, which again, by the basalts of Iceland and Jan Mayen, are connected with modern times. It is, of course, possible that volcanoes and volcanic formations of a similar period may exist in the Unknown North, or in the insufficiently explored parts of the Arctic Regions. But according to what we know at present, it might seem natural to conclude that the formation of the North Polar basin by sinking of the sea-bottom was finished near the end of the Jurassic and the beginning of the Cretaceous period; whilst the bottom of the Norwegian sea has, in its southern and eastern parts, been sinking in during the Tertiary period, and these disturbances are not yet quite finished in some parts (near Jan Mayen and Iceland).

If we knew the edges all round of such a deep basin, formed by sinking in of the Earth's crust, we could assume, with a high degree of certainty, that extensive land masses cannot possibly exist inside these edges, rising from the bottom of the deep basin. For we cannot possibly assume that, when the basin was formed by sinking of the crust, an isolated block of land, or what the geologist would call a "horst," should have been left in the middle, without any connection with the continental coasts or land masses surrounding the basin, and without taking part in the universal sinking of the crust on all sides of it. This does not, however, exclude the possibility that more or less isolated

volcanic islands, like Jan Mayen, may occur inside the edges of such a deep basin, rising up from the depths of the sea, and built up by volcanic action during or after the sinking of the sea-bottom.

What has just been said demonstrates the importance of knowing the actual edge of the deep basin on all sides of the North Polar sea. But this edge is very far from coinciding with the visible coasts of the continent, as is easily seen by a glance at the North Polar map at the end of the present number. If we do not know the depths of the sea outside the coast, and the chief morphological features of its bottom, the knowledge of the coasts alone tells us, in fact, very little in this respect. We thus see the great importance of exploring, not only the coasts and the surface of the sea, but we have to sound its depths, and trace the morphological features of its bottom. For instance, as long as we know hardly any soundings to the north of the American Arctic archipelago and Greenland, and only very few north of Alaska, it is almost hopeless to try to draw any conclusions from the known geographical and geomorphological features as to possible land masses to the north of this region. I shall come back to this a little later, but I wish to mention what we know about the

Continental Shelf of the North Polar Basin.

What is a *continental shelf*? By this expression we mean the submarine platform surrounding most continental coasts, and extending in some regions far seawards as a very level drowned plain, generally at a depth of between 40 and 80 fathoms below the present sea-surface. At its edge the sea-bottom, as a rule, suddenly breaks off and slopes comparatively steeply towards the deep basins of the ocean (see Fig. 1). This shelf is a most important geomorphological feature, which has not hitherto, in my opinion, had the attention of geographers to the extent which it deserves. When systematically studied, it will certainly give us much more information about the history of continents and the surface of the Earth than has hitherto been fully realized. Many geographers and geologists have paid attention to this interesting feature, but, as a rule, more or less accidentally. In a memoir on "The Bathymetrical Features of the North Polar Seas, with a Discussion on the Continental Shelves and Previous Oscillations of the Shore-Line," * I tried some years ago to take up this subject for a more universal investigation, but it is a complicated question in several respects, as the soundings and our knowledge of the sea-bottom are still very imperfect in most regions, even near the coasts.

How have the continental shelves been formed? They are partly

* *The Norwegian North Polar Expedition*, 1893–96. *Scientific Results*, vol. 4, No. 13. Christiania, 1904. See also my paper, "Oscillations of Shore-lines," the *Geographical Journal*, December, 1905.

built up by river and sea sediments, and are partly cut by a joint effect of atmospheric erosion and marine denudation caused by wave-action.

The greater part of the area of the continental shelves has once been dry land, and their edges indicate, therefore, more or less the real boundaries of the continents. They have, as a rule, comparatively lately been elevated above sea-level, as is proved by the drowned valleys still traversing them in many places. I ought, perhaps, already here to point out that there is a marked difference between a submarine or drowned river-valley and a submarine fjord, the latter having all

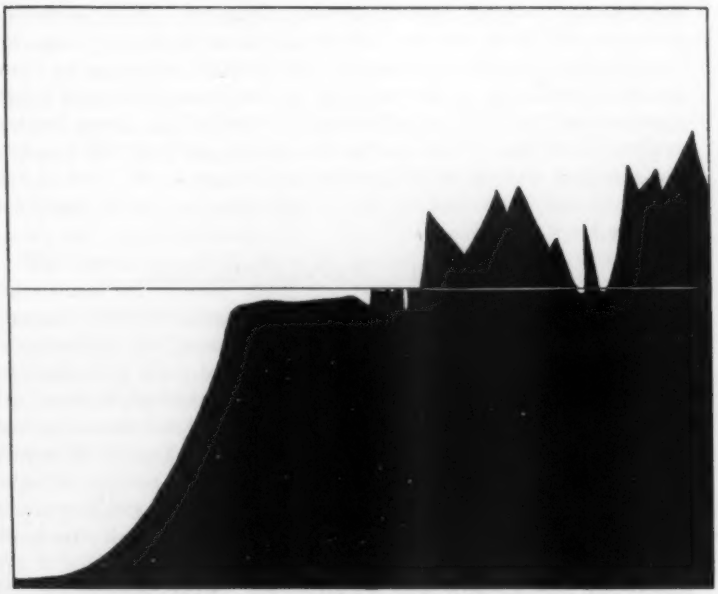

FIG. 1.—SECTION ACROSS CONTINENTAL SHELF IN REGION OF HARD PRIMARY ROCK, NORTH OF LOFOTEN ISLANDS. VERTICAL SCALE EXAGGERATED 25 TIMES.

the characteristics of a valley excavated, or at least shaped, by glacial erosion, as for instance in Norway. The occurrence of submarine fjords on a continental shelf does not with certainty prove that the latter has been elevated into dry land when the fjords were formed or were reopened for the last time, as they may have been reopened and deepened at present sea-level by submarine glacial erosion.

After this digression we ought to return to our North Polar sea, where we not only wish to know the distribution of land and water on the sea-surface, but where we wish almost still more to know the land and water under the ice-covered surface. It would be of the very

greatest interest to know the form and northward extension of the continental shelves from the known coasts into the still Unknown North; we should then be able to trace out the chief geographical features of this region, and get an idea of the actual shape and extension of the deep North Polar basin. A satisfactory exploration of the North Polar continental shelf would therefore be a great achievement worth trying, compared with which the question whether islands project above water-surface from the shelf or not is of minor importance.

The actual edge of the North Polar continental shelf has only been found in two different places, viz. north-west of the New Siberian islands, and north of Spitsbergen. In the entire rest of the North Polar sea the situation of the continental shelf is still unknown.

The Continental Shelf North of Siberia.

The *Fram* soundings proved the edge of the continental shelf north-north-west of the New-Siberian islands to be about 400 statute miles from the Siberian coast, and the shelf is unusually shallow and flat, less than 50 fathoms below sea-surface. Beyond its edge the sea-bottom forms a very sudden and steep slope towards the deep basin (see Fig. 2).

Eastward from this region the continental shelf extends towards Bering straits, as an unusually wide and flat submarine plain at depths of usually less than 50 fathoms below sea-surface. The New Siberian islands, Bennett island, Henrietta and Jeannette islands, Wrangell island, and Herald island are lying on this flat shelf. As proved by Baron Toll, Bennett island is very small, only some few miles in diameter. This might, I believe, have been expected from the observations of the ice-drift during the *Fram* Expedition; but how far north the continental shelf extends in this region is unknown. The numerous soundings taken during the drift of the *Jeannette* prove that the continental shelf between Bennett island and Bering straits is at least 300 miles broad, but how much broader is unknown. It is possible that the *Jeannette* was actually near the edge of the shelf during some part of the drift, as during northerly turns in the drift near the longitude of 170° E. the depths suddenly increased from the general depth of between 30 and 40 fathoms to about 70 and 80 fathoms. This might have been the beginning of the continental slope towards the deep basin; but it is also possible that it was only a submarine valley or channel, beyond which the continental shelf extended further northwards. North of Bering straits numerous soundings have been taken, showing that the continental shelf there extends at least to a similar distance of about 300 miles from the Siberian coast, and its depth is very much the same, about 30 to 40 fathoms. Some of the northernmost soundings, north-east of Wrangell island, give, however, greater depths, increasing towards 80 fathoms. It is uncertain whether this increase of

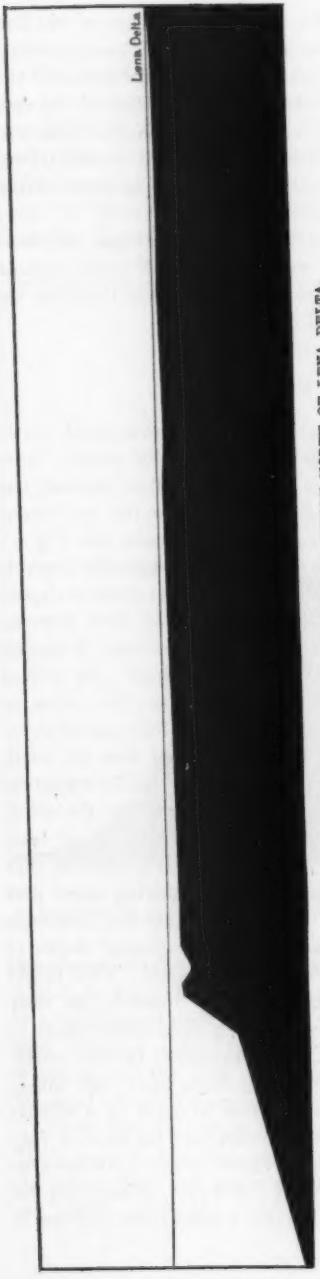

FIG. 2.—SECTION ACROSS THE SIBERIAN CONTINENTAL SHELF NORTH OF LENA DELTA.

depth indicates the actual edge of the shelf, as might seem probable, or simply submarine valleys.

The edge of the shelf to the north of western Siberia, between the *Fram's* northward route near the New Siberian islands and Franz Josef Land, is unknown, but in this region we know, however, from the *Fram's* drift, that there is a deep basin to the north. It seems probable that the edge comes nearer to the Chelyuskin peninsula than to any other part of the Siberian coast. Here we have one sounding of 68 fathoms of the *Vega*, quite near the northern promontory, whilst the general floor of the Siberian continental shelf lies, as before mentioned, at a level of about 30 and 40 fathoms or even less.

About midway between Cape Chelyuskin and the northern end of Novaya Zemlya a small island, Ensomheden (or Lonely island), rises above the sea-surface from the shelf. It was found accidentally by a Norwegian walrus hunter, Captain E. Johannesen, and there may be more islands in this region, but the edge of the shelf is not known.

The shelf north of the Franz Josef archipelago is unknown. Julius Payer thought that in Franz Josef Land he and Weyprecht had discovered the southern coasts of an extensive ice-covered continent producing icebergs like those of Greenland. Even men like Admiral Melville, who had experienced the drift of the *Jeannette*, have held the view that the north pole could be reached by a sledge-expedition over the surface of this continent; a task which Captain J. F. Jackson set out to do.

By the sledge-journey of Captain Johansen and myself, this continent was sunk into the sea. By Jackson's explorations and ours, as well as those of Leigh Smith and others, Franz Josef Land was broken up into an archipelago of many comparatively small islands. And by the expedition of the Duke of the Abruzzi, even Petermann Land and King Oscar Land, which Payer thought to have seen to the north, was for ever obliterated. The Franz Josef archipelago rises from the continental shelf, but how near its margin cannot be decided. Although Johansen and I must have crossed its edge coming from the north, we cannot tell where the edge was, which shows how very limited the knowledge obtained by an ordinary sledge-expedition actually is. As the Franz Josef archipelago is built up of basalts and Jurassic clays, which give way rapidly to erosion, it seems probable that the marine denudation during ages has been able to form a comparatively broad continental shelf to the north of its coasts.

On the east side of the Franz Josef archipelago there may possibly be still unknown islands. During our sledge journey north-east of that archipelago we discovered, in July, 1895, that the southward drift of the ice, which northerly winds produced, was stopped by land to the south of us, and this might indicate at least some islands east of those now known. Mr. Baldwin, of the Wellman Expedition in 1899, actually discovered an island in this region, but I have never seen a detailed description of the work of that expedition.

Between Franz Josef Land and the Siberian coast the deep North Polar basin forms probably a deep embayment extending southwards. This is proved by some soundings, deep-sea temperatures, and water-samples which Admiral Makaroff took in the sea north of Novaya Zemlya in 1901.*

The continental shelf north of Alaska may be comparatively narrow, as a few soundings of 140 fathoms with no bottom have been taken 50 miles from the coast. These soundings may indicate the edge of the shelf; but there is, of course, also the possibility that they have been taken in submarine fjords. An exploration of the extension and nature of the continental shelf off this coast would be of great value, and interesting results in that respect could certainly be attained without great difficulties by properly equipped sledge-expeditions starting from the Alaskan coast.

We know practically nothing at present with regard to the extension and nature of the polar continental shelf north of the American Arctic archipelago, and we cannot say much as to what might be expected in that direction. Sir Albert Markham's sounding of 72 fathoms at his

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* See Nansen, "Northern Waters," *Videnskabs-Selskabets Skrifter* (Christiania, 1906), 1, No. 3, pp. 49–54. See also *Norwegian North Polar Expedition*, 1893–96 *Scientific Results*, vol. 4, No. 13, p. 16.

farthest north is the only sounding known, taken at some distance from land on that shelf. We cannot know whether this one interesting sounding was near the edge of the shelf or not, whether it indicates the level of the general floor of the shelf or whether it was taken in one of the submarine fjords, which are probably numerous in that region.

In my memoir, mentioned before, I pointed out that the continental shelves have a tendency to be narrow outside high and mountainous coasts, especially where these are built up of hard primary rocks, whilst they are broader outside low coasts; I therefore maintained that we cannot expect the continental shelf to be very broad north of Greenland, Ellesmere Land or Grinnell Land, and Axel Heiberg Land, or at least not so broad as north of Siberia. Dr. J. W. Spencer* has afterwards accentuated this view. It should, however, be considered that the above rule is especially valid in regions where the direction of the mountains along the coast also indicates the direction of the coast-line, and is intimately connected with the formation of the continental slope off the coast, as is, for instance, the case in Norway. Where this is not so, the conditions are often different; *e.g.* the fairly high coasts of Finmarken, which are not formed by primary rocks, have a very extensive shelf to the north. Novaya Zemlya is a mountainous land, but with rocks from different periods, and it is situated in an extensive shallow sea, on an enormous continental shelf. Spitsbergen is built up of different rocks; it has a narrow shelf to the west and north, but very broad to the south and east.

The islands of the American Arctic archipelago are also built up of rocks from various geological periods, and we still know too little to say much about their tectonic structure. There are, however, hardly any mountain formations or mountain chains corresponding to the trend of the known northern coasts. Nor can we say that they are specially high and mountainous. On Sverdrup's new lands there seemed, for instance, to be a low foreland towards the north. What we know in this respect does not, therefore, exclude the possibility of an extensive continental shelf to the north, *e.g.* off Sverdrup's new lands, or north and west of Prince Patrick island and Banks island.

Dr. Spencer assumes that the American Arctic archipelago is a dissected plateau region originally fashioned by atmospheric agents, and subsequently submerged, more or less. He consequently considers the present sounds between the islands to be drowned river valleys, and as the known soundings show that some of these are very deep, he comes to the conclusion that their length before they reach the deep sea, *i.e.* the edge of the continental shelf, cannot extend very far beyond the known coast to the north and west. I am, however, afraid that this

* J. W. Spencer, "On the Physiographic Improbability of Land at the North Pole," *American Journal of Science*, vol. 19, May, 1905.

argument does not carry great weight in this particular region. Great depths of submarine fjords at certain places do not tell much about the length and depth of the fjord outside the deep hollows, wherever the lands have been exposed to glacial erosion. As examples might be mentioned the Norwegian submarine channel off the southern coast of Norway, or even the Baltic, where deep hollows have been excavated at great distances from the deep sea.

And besides, it has to be considered that the American Arctic archipelago exhibits in several respects features which are quite unique and exceptional on the Earth's surface. If, for instance, we assume that the sounds between these many islands are actually submerged fjords—*i.e.* original river-valleys which have afterwards been excavated and given their present shape by glaciers—we will not here consider whether they may originally be due to special tectonic structures—then these fjords are without comparison the greatest fjords of the world. Take, for instance, a fjord like the one extending through McClure strait, M'Clintock channel, and Queen Maud sea; it has such enormous dimensions that the greatest fjords of Norway or even those of north-eastern Greenland would be mere dwarfs in comparison. It might more appropriately be compared with the Baltic, or the great submarine valleys of the Barents sea. We know, however, very little about the depths of these sounds and fjords, and a systematic survey of them in connection with an exploration of the geological structure of their coasts would be most interesting. We might then hope to obtain a knowledge of the history and formation of these most remarkable features, which would be of very great value.

What we know is, however, sufficient to warn us that in these regions there are exceptional conditions, and it is very difficult to apply here conclusions drawn from geomorphological features observed in other parts of the world. These regions were probably near the home of the great North American Ice Age, in a similar way as the regions of the Baltic and the White sea were near the home of the great European Ice Age; the land has been even more dissected into islands and peninsulas than has been the case in the latter regions, whatever the first cause of this dissection might have been.

To summarize the results of the above discussion, it might be said that the known geographical and geomorphological features of the Arctic regions do not exclude the possibility of a wide extension of the continental shelf beyond the northernmost known islands of the American Arctic archipelago and Greenland, and there may be unknown lands on this shelf in the Unknown North. It is also possible that the Siberian continental shelf may have northward extensions with land in the region between the New Siberian islands and Alaska.

To mention a parallel, I may point out that if we had only known the northern coasts of Norway, Russia, Novaya Zemlya, and Siberia, and

the sea outside those coasts, and if Franz Josef Land, Spitsbergen, and Bear island, etc., had not been discovered, it would have been very difficult indeed to infer their existence from the geomorphological features we had then known; and what is more important, the existence of the enormous continental shelf to the north of these coasts would still remain unknown.

It would be an achievement of the very greatest importance, from a geomorphological point of view, to determine the edge of the continental shelf in as many places as possible round the North Polar basin.

The North Polar Currents and the Drift of the Ice.

Let us now examine what the known oceanographical conditions of the North Polar sea might possibly tell us about the Unknown North, and let us first direct our attention towards the *currents* in this sea-basin.

As may possibly be known, it was a careful study of the sea-currents and the drift of the ice, etc., which led me to the conclusion that there was a great sea to the north of Spitsbergen and Franz Josef Land, and that this sea was crossed by a drift-current which might be used to carry a ship across the then unknown north from the region of the New Siberian islands towards the opening between Spitsbergen and Greenland. It is, perhaps, also known to you that the *Fram* Expedition actually proved this hypothesis to be true. In a similar manner, a study of what is now known about the currents and the ice-drifts of the North Polar sea might give us some reliable indications as to the conditions in at least some part of the now Unknown North. I shall not go into details on this somewhat special subject, but try only to mention the more prominent features.

If the *Fram* had not worked her way, under Captain Sverdrup's excellent leadership, out of the ice north of Spitsbergen, in 1896, she would have been carried south-westwards with the ice-drift, or, as it is usually called, the East Greenland polar current, along the East Greenland coast towards Iceland. We can, however, say with much certainty that she would not in this way have come near to the Greenland coast, but would have been separated from it by a broad belt of polar ice, which must come from an extensive area to the north of the *Fram's* route. The mean velocity with which the ice is carried southwards by the Greenland polar current is sensibly greater—three or four times greater—than that with which the *Fram* was drifted along, even during the latter part of her drift, when the velocity was greatest. Unless we assume that the velocity of the ice-drift is very much greater to the north of the *Fram's* track, we are consequently obliged to conclude that the ice-drift converges from a considerable area in the Unknown North, in order to produce the polar ice-masses of the Greenland polar current. I consequently came

to the conclusion that there cannot be much land to the north and north-west of the *Fram's* track in the region north of Greenland. The correctness of this conclusion seems to have been borne out by the experiences during Peary's latest expedition. He was greatly hindered in his journey by the strong eastward drift of the ice in the region north of Greenland; and he met with long water-lanes and channels going in an easterly direction. These long open-water channels might be compared to some similar ones Johansen and I met with on our sledge-journey southwards towards Franz Josef Land; they extended in a westerly or south-westerly direction, probably more or less in the direction of the ice-drift in that region. It seems as if the ice-drift in the sea to the north of Spitsbergen, Greenland, and Ellesmere Land (Grinnell Land) converge towards the opening between Spitsbergen and Greenland, as was expected beforehand. But Peary's experiences do not entirely exclude the possibility that there might have been some land somewhere to the north of his farthest. Little can be said about this as long as the depth of the sea over which he travelled is unknown. As, however, the ice seems to have come drifting freely from the west, it is improbable that there has been much land anywhere near his route in that direction.

Mr. R. A. Harris, of the United States Coast and Geodetic Survey, has, in a paper on "Evidences of Land near the North Pole," * set forth the hypothesis that the surface currents in the shallow sea to the north of Bering straits, Alaska, and Eastern Siberia, prove the existence of an extensive land to the north in that region (see Fig. 3). He maintains that currents in this region run eastward in the sea north of Alaska, and north-westwards north of Siberia. He speaks of these currents as if they ran like rivers in the sea from certain points, *e.g.* from Herald island to certain points, *e.g.* to Cape Farewell. He has hardly realized that the surface currents of the North Polar sea are drift-currents extending over great areas, and that the winds influence them, and to some great extent create them. He gives us no explanation of how or where his two currents originate, but if they really existed, as he imagines, they would, if anything, rather prove that there can be no extensive land to the north, enclosing the sea of this region into a broad channel, as on his map. He has evidently not realized that if the water were running both north-westwards and eastwards out of his shallow enclosed sea-channel, the latter would very soon run dry in the middle. For wherefrom should then the supply of water for these two currents come? As Sir Clements Markham has already pointed out, it cannot come from the south through the narrow and shallow Bering straits, and the sea to the north he has himself landlocked. We know as yet very little about the currents in this region. The ice-drift is there very slow and irregular,

* 'The Eighth International Geographic Congress, Washington,' pp. 397–406.

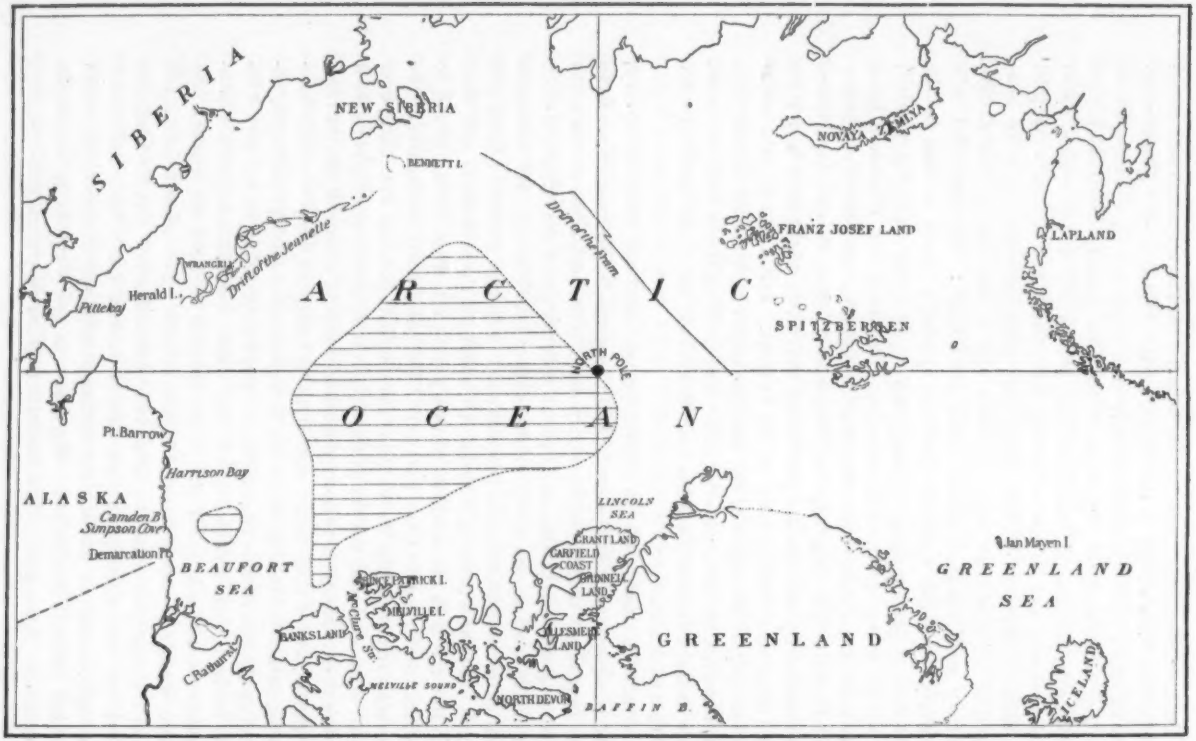

FIG. 3.—FACSIMILE OF HARRIS'S MAP OF ARCTIC REGIONS, SHOWING OUTLINE OF INDICATED NORTH POLAR LAND.
(From *National Geographic Magazine*, vol. xv., p. 256)

and seems to be almost entirely dependent on the winds. We cannot, therefore, expect to get much information from that source as to the possibility of land to the north.

Sir Clements Markham mentions a point to which Mr. Einar Mikkelsen had drawn his attention, and which he thinks to be of considerable importance. It is the steady increase of the mean velocity of the drift of the *Jeannette* during her route westwards. He thinks that this acceleration of the drift must be due to the effect of the Siberian rivers; but as the *Jeannette* was not carried more northwards by this effect, he considers it probable that there was some land to the north to stop the drift in that direction. But Markham has evidently not been fully aware that the drift of the *Jeannette* was to a very great extent caused by the winds. It would be necessary to know exactly the strength and directions of the winds, and to compare them with the corresponding distances and directions drifted by the *Jeannette*, in order to draw any conclusions as to the relation between her drift and the possibility or probability of land to the north; and even then it would be an extremely difficult task. If we assume that the drift of the *Jeannette* was chiefly caused by the winds, it might, perhaps, with equal right be said that the westward increase of the mean velocity of her drift indicates no land to the north in that region, for if there had been land, this would stop the movements of the ice, and consequently reduce the effect of the wind on the ice.

By a careful analysis of the wind-observations as compared with the drift during the *Fram* Expedition, I have tried to find out the direction of the permanent currents of the surface water independent of the changing winds; and the results I obtained agree remarkably well with each other, giving a surface current running in the direction of Franz Josef Land and Spitsbergen (see Fig. 4).*

This result is, however, difficult to explain. For if we assume that the current is formed by the light outflowing surface water of the polar sea, diluted by the river-water from Siberia and America, this outflowing water would, owing to the Earth's rotation, be deflected towards the right, and would consequently run out along the right-hand side of the basin, *i.e.* along the Greenland side. If, therefore, the current actually runs in the direction I have found, it might seem to indicate that there was land to the north of the *Fram's* route, preventing it from running in that direction. But even then it seems very puzzling that the current does not at least follow the direction of the coast of that unknown land, instead of running so far towards the left. It is, therefore, hardly probable that the actual current is running in the direction I have found; the movement of the ice to the north of our track may,

* See *The Norwegian North Polar Expedition*, 1893–96. *Scientific Results*, vol. 3, No. 9, 1902, plate 1, and pp. 357 *et seq.*

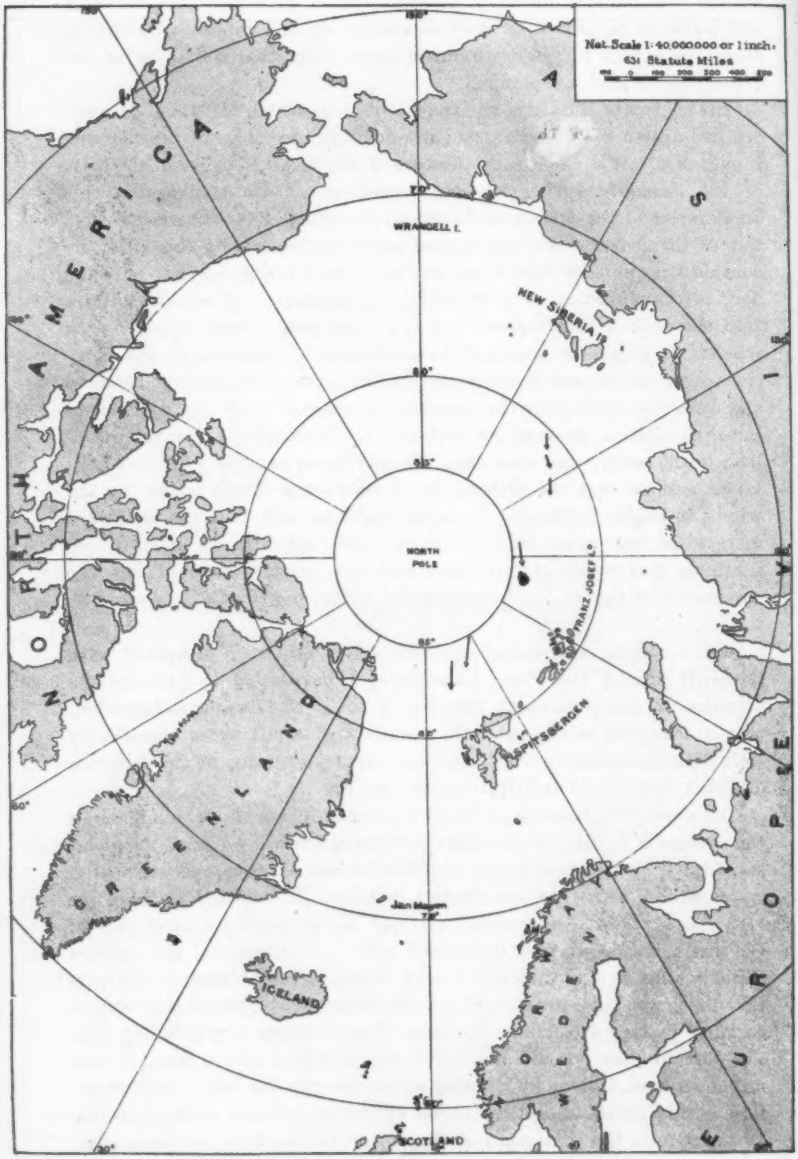

FIG. 4.—THE ARROWS INDICATE DIRECTION AND RELATIVE VELOCITY OF PERMANENT CURRENT OF SURFACE WATER, AS FOUND BY THE *FRAM* OBSERVATIONS, 1893–96.

for instance, have influenced the movements of the ice near the ship, and thus I may have come to somewhat misleading results as to the surface currents.

The Nature of the Ice in the Different Parts of the North Polar Sea.

The North Polar sea is covered by an almost continuous sheet of ice, which, however, is nowhere at rest, except for short periods near the coasts and between islands in the winter. On the whole, it is everywhere carried along across the sea by winds and currents; at some places slower, at others faster. The chief direction of the drift is from the Siberian-Alaskan side towards the opening between Spitsbergen and Greenland, as was proved by the drift of the *Fram*, in connection with that of the *Jeannette*, and also by other evidences, especially the driftwood. A smaller amount of ice is carried out through the channels of the American Arctic archipelago into Baffin bay, and southwards towards Labrador and Newfoundland. Some ice is also carried out south of Franz Josef Land.

By studying carefully the nature of the ice, its thickness, age, appearance, etc., along the north polar coasts, one might possibly attain some information as to the sea to the north, from which the ice has come or towards which it may be drifting. This has been done by various authors, but not always with success. It is naturally essential to know which features of the ice it is of special importance to pay attention to. If, for instance, in a region like the Siberian sea, with a low mean temperature of the year, we find comparatively young ice, with no great thicknesses of the flat floes, it proves that the general ice-drift in that region is directed seawards from the coasts, and no ice is allowed to remain there to grow very old. The height and dimensions of the hummocks and ice-ridges are of little importance in this respect; they may, however, prove that there have been heavy ice-pressures, which may be caused by winds, or still more by tidal currents. These hummocks prove, furthermore, that the sea is not enclosed, and not protected by land in a near vicinity, for then there could hardly be any heavy ice-pressures to produce them.

If, on the other hand, we find in a sea like that off the northern coasts of Greenland and Ellesmere Land, very heavy and old ice, where the flat floes have a very great thickness, and where there are enormous hummocks which are very old, and to a great extent shoved landwards into shallower water, this may tell us that the ice has drifted for many years in the sea, and that the general direction of the ice-drift to the north is directed more or less towards the coasts, and is very slow, being blocked by the land. It would, however, be a mistake, as some authors have done, to infer from these circumstances, that the ice in this region is held by land to the north, which prevents it from being

carried away. The unusually great hummocks point, rather in the opposite direction; they must have been formed by very heavy ice-pressures, which cannot occur in an enclosed sea, but require an extensive sea-area where extensive ice-masses are in motion.

In order to compare the ice of one region with that of another, it is essential to get actual measurements of the ice, especially of the flat floes that are not piled up by ice-pressures, and to have trustworthy statements as to the age of the ice, as may be found out by its salinity, its snow-layers, its accumulations of dust and diatoms on the surface, etc. It would also be of interest to know, by exact measurements, the actual height of the hummocks, etc. To go by the ordinary popular descriptions often met with in accounts of Arctic voyages may be very misleading. The ice which may make an imposing impression upon one observer, might make a very different impression upon another. If, for instance, Payer's somewhat fantastic description of the ice in which the *Thegethoff* drifted north of Novaya Zemlya, be compared with descriptions of the ice off the northern coasts of the American Arctic archipelago, one might come to the conclusion that the former ice was much the heavier. Payer even speaks of hummocks with heights of 40 and 50 feet as quite common. Now we know, however, that the ice in this region is comparatively young and thin, and the hummocks hardly ever exceed 20 feet in height by sober measurements.

We have now actually descriptions by various travellers of the ice along the whole of the western and northern coasts of the American Arctic archipelago, from Alaska to the north coast of Greenland—Collinson and others north of Alaska, McClure and Sherard Osborn along the west coast of Banks Land, M'Clintock and Mecham along the west coast of Prince Patrick island, Sverdrup along the coast of his new lands (E. and A. Rignes islands, and Axel Heiberg island), Aldrich, A. Markham, Nares, Beaumont, Lockwood and Greely, and Peary along the northern coasts of Ellesmere Land and Greenland. It might, therefore, seem possible to come to some conclusion as to the region to the north and west by a careful comparison of these descriptions; but unfortunately they are all more or less popular descriptions, with very few measurements. And besides, it has to be considered that the nature of the coast itself may have a great influence upon the appearance of the ice; *e.g.* a flat coast with shallow sea outside may be bordered by ice with grounded hummocks, which have an appearance different from that of ice outside a steep coast with deep water, although it may actually be the same ice. In fact, the appearance of the ice may differ very much along the same coast, even at very short distances. It is, therefore, hardly possible to come to any certain conclusions as to the Unknown North from the known descriptions of the coast ice.

Mr. R. A. Harris makes, in the above-mentioned paper, the mistake of drawing rather far-reaching conclusions from such popular and

indistinct descriptions of ice. He attaches great importance to the very heavy old ice, which is said to have been met with in the Beaufort sea; but the quotation he gives from Osborn's description, in order to prove it, is not fortunate. Such descriptions as, for instance, "ice of stupendous thickness and in extensive floes, some 7 or 8 miles in extent, not flat but rugged with the accumulated snow, frost, and thaws of centuries," can hardly be said to carry any very accurate idea of what kind of ice has actually been seen. Whether we are expected to take such expressions as "accumulated snow of centuries" simply as an ornament of *licensia poetica*, or as a description of the author's real view, I do not know. I have in another place * pointed out that the drift-ice in the north polar basin, where the *Fram* drifted, does not, as a rule, attain a higher age than five years; how much older it may become on the American side we do not yet know.†

But even if it be so that the ice of the Beaufort sea is very heavy and old, it proves nothing as to the probable existence of land to the north. It only shows that the drift of the ice is very slow in this region, as it may be blocked by the land already known. That the ice is rugged proves that it has been exposed to ice-pressures, and this is no evidence in favour of unknown land seawards, or to the north; it proves nothing in this respect, only that the sea is not, at any rate, land-locked.

Sir Clements Markham has mentioned, in his above-mentioned paper, that Sir Richard Collinson attempted to cross the ice northward from Alaska, but, finding very heavy ice, he was compelled to return after a day or two. This proves only that the ice in this region had been much broken up by ice-pressures, but gives no indication as to possible land to the north. If anything, the evidence would go in the opposite direction.

The fact that the ice in this region is never seen to recede far northward from the northern coast of Alaska, nor westwards from Banks Land, points no more to land to the north, as Mr. Harris suggests, than, for instance, the circumstance that the ice never seems to recede much northward from the northern coasts of Taimur peninsula and Cape Chelyuskin, and Ellesmere Land, and Greenland. The distribution of the ice is dependent on its drift, which is greatly influenced by the prevailing winds.

(*To be continued.*)

* See *Norwegian North Polar Expedition*, 1893–96. *Scientific Results*, vol. 3, No. 9.

† If it were actually possible that the ice in some enclosed land-locked sea could become centuries old, and be covered by accumulated snow of centuries, it must naturally be perfectly flat, as there cannot be any movement or pressures in the ice. Osborn's or McClure's description of the ice of Banks Land as being very old, with a surface of rounded hill and dale, seems to prove that this ice had not been exposed to ice-pressures lately. Farthest north, in the centre of the North Polar basin, I found, however, ice of which a similar description could well be given.

THE FAN MOUNTAINS IN THE DUAB OF TURKESTAN.*

By W. RICKMER RICKMERS.

Just off the north-eastern face of Khon Tagh we climb an old moraine, which divides the valley floor into an upper and a lower level. Proceeding further, we branch off from the Pasrud for a while, and climb the Laudan valley by a good path, which leads through fine groves of ancient thuyas, gnarled, twisted, and weather-beaten. Emerging upon pleasant downs, where hidden glens are full of sweet herbs for the horses, we make our camp at a height of 9000 feet, which is more or less the upper limit of the thuya tree, the good friend who supplies us with fuel. Grass ascends to about 12,000 feet, and in valleys of the Pamir type even higher, as we saw at Tupchek. A stiff breeze, blowing from the head of the valley, teases the flapping canvas of the tent; the noise of camp life is answered by the shrill whistle of the marmot as it dives into its burrow. These little red-coats are very plentiful, and so is the eagle, which spies them from above.

Next day we are impatient to reach the top of the pass, in order to enjoy what we have been longing for: a mountain view in bracing air, after those tiring marches through the ovens of hell-baked stone. At first the rise is gentle along the middle of the trough. The sun is up, and the traffic is astir, coming and going—horsemen proud of purse and bronze-faced wayfarers with heavy packs. Stout staves in hand, they have risen from behind their wind-shields, low walls blackened with the smoke of many fires. Bethinking ourselves of the flesh-pots, we await the progress of long streamers of dust, the pennants with which a cattle-dealer heralds his approach. We pay him his presumptive price, and pick a strapping yearling from the herd, which is to be sold at Samarkand. Yesterday we saw this flock sleeping in the sun at noon, closely huddled together and motionless, like a monster bale of wool. To-day they have begun to move at early morn; three hundred well-nourished sheep, black, brown, yellow, and white, fine strong animals, with the short curly fleece that seems to speak of wild forefathers, as does the wiry leg. But domestic is the blubbery bump of fat which wobbles on their buttocks as they walk. In front marches a small guard of clever goats, long-haired and dignified, as if aware of their responsibility as leaders. Behind are black calves, slow and clumsy. Then the drivers, urging forward with stick and stone, and blowing through their teeth the sound of the spitting cat; on their heels the faithful dogs, slinking drowsily, *blasé*. And last of all, arrayed in blue khalat and white chalma, the owner, enthroned upon a pair of carpet saddle-bags that almost hide the shaggy pony.

We push on. The pasture-mat, now almost brittle straw, is notched

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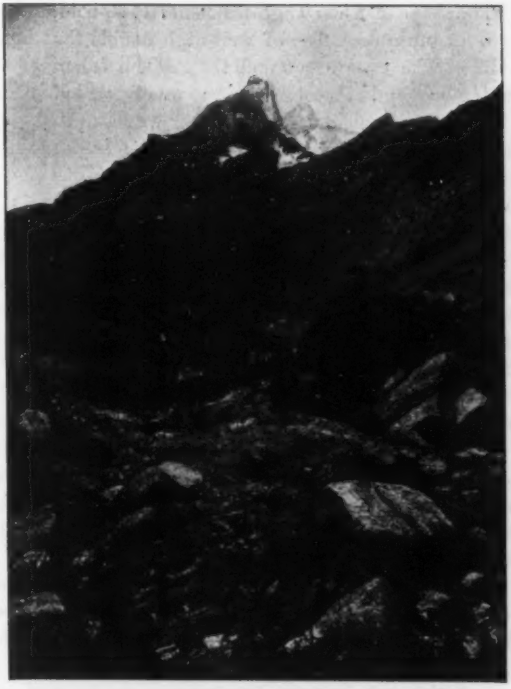
* Continued from p. 371. Map, p. 468.

into long strips by the feet of grazing animals. This makes the slopes look like a hatched map. But the thin silvery lines of the watercourses are bordered with a fringe of lawn, sprinkled by the splashing stream, and cropped close by every beast. The gardener of a tennis-ground would turn green with envy.

Soon we meet the first patches of snow, remains of avalanches covered with a film of slimy earth. And here the thuya begins to leave us, only sending up those twisted dwarfs, who can squat under weighty



GREAT LAKE.

snow, or crouch in hollows from an icy blast. Some drought-hard plants now wear their nuptial garb; the tough broom, the tangled clusters of yellow roses, and the royal thistle in its gorgeous ruffle of glossy grey leaves drawn out into long spines. Near the water nasturtium and a tiny dandelion are in flower. Presently our attention is claimed by the steepness of the path, which climbs a long and dreary slope by endless zigzags, and we restrain our curiosity until the top of the pass is reached (about 12,000 feet). Then we lift our eyes to look

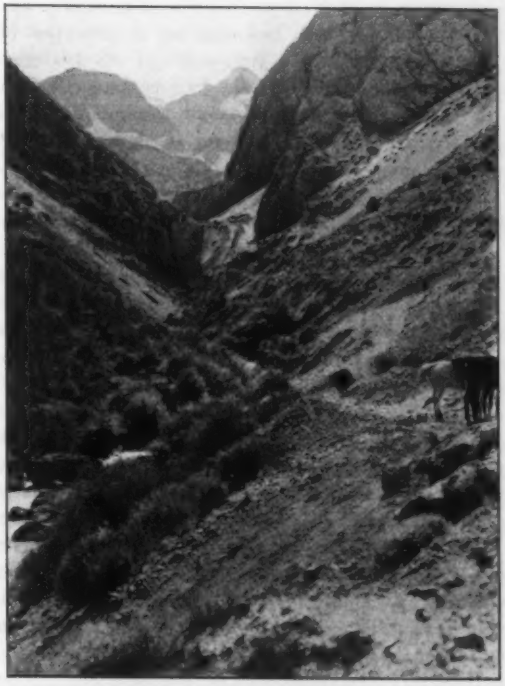
around, and our silence and our talk speak alike of wonder and awe and of the eagerness of inquiry. First comes the overpowering nearness of those gigantic piles Khon Tagh and Chapdara. In the latter, which is drawn out into a long frontage of tremendous cliffs, we easily recognize the mountain visible from the plains of Pendjekent. The other is a colossal pyramid, with flanks carved out to make tiers of vertical precipices which surround the corries at their base. Where have I seen such walls before? Ushba, the Terrible, in the fastnesses of the Caucasus, comes back to memory. On its western side there is a sheer drop of 3000 feet. The shape of Khon Tagh is not nearly so bold, but its granite quarry shows an unbroken face of well-nigh double that height. Did I say granite? The square cut and the reddish colour of the blocks lead us at first to think that the two mountains which we have compared are built of the same stone. But later we learn that the material of the great Fan peaks is lime covered with a thin scale of shining rust.

Turning towards the background of the east, sight travels into the long vista of the Yagnob, between rows of many summits that lead further and further until the haze of distance blurs the outlines, and the needle-crags of Khakhifta are but weird pillars, like spectres vanishing in the mist. On the left is Vashan Tagh, a long embankment of slanting masonry which sends round the curve of its main spur to our standpoint. In the west are dry ridges hurrying away to the flat expanse of Turkestan, and immediately below us is a group of morainic lakes, little bits of round glass among a profusion of black dots, or, in other words, sheets of clear water on a plateau spotted with trees.

Studying the Russian 10-verst map (1 : 420,000), we find a good record of everything that has some practical interest; cultivated valleys, villages and hamlets, roads, bridges, and passes. It is, in fact, a splendid and valuable piece of work, covering, as it does, thousands of square miles of mountainous country. A very large staff of topographical officers have been busy for many years, with the result that we have before us a complete survey of the main features between Fort Pamir and Bokhara city. The realm of ice and snow they have filled up with a few located peaks surrounded by caterpillars of uncertain contortions and dotted lines. That is not a fault, for such detail had to stand back in view of more pressing needs, and has been left to the mountaineer. My own map does not claim to be a marvel of accuracy; it only gives the most important of the higher ridges, and its chief interest lies in the high valley of the Pasrud sources, never before visited by Europeans.

As to the names, I have adhered as much as possible to those of the Russian sheet. Native information seemed to favour Chapdara instead of Khon Tagh, and Chimtarga instead of Chapdara. But then, the Russian map mentions a big mountain called Chimtarga much further south, and owing to loss of time I have not been able to make sure of

its existence, whereabouts, and name. The name of Chapdara is therefore given to the peak whose position coincides with that of the ordnance, and Khon Tagh is the great mass which seems to have escaped the notice of the Russians. I hope to investigate the matter next year. It is always better to keep to the names on the first good maps, unless they be flagrantly unreasonable or misspelt. One must not listen too much to the inhabitants of different valleys, for in each the same mountain has another name, generally that of the pastures below it. The



PASRUD VALLEY JUST BELOW NATURAL BRIDGE.

shepherds, hunters, and guides of illiterate countries learn from the tourist the habit of choosing one and the same name for a mountain, no matter from which side it is seen. Topographic nomenclature is therefore more important to us, the tourists, travellers, and writers. On a topographic map (which is seen from above, from *one* direction only) a point is an absolute entity; the horizontal etymological relativity of a point can only be thrashed out in a book. The literature of civilized nations is so complicated that traditional names are havens of rest from

which we survey the ocean of undefined spaces; they are the fixed points which enable us to trace general outlines. A striking case in point is that of the map of the Central Caucasus, where Dykhtau has been changed into Koshtantau, and Koshtantau into Dykhtau, so that even I can only remember which is which when I have books at hand and can spend at least half an hour over the puzzle. This was done with the estimable but ludicrously belated ambition to satisfy the science of folk-lore. But a mere statement in a book of native usage would have sufficed,* whereas it was quite out of date to change ideas—not at all erroneous in themselves (a name is a name), nor leading to any misunderstandings—which had obtained the sanction of a famous history. This change affects a generation of mountaineers and the thousands of readers who identify the two peaks (or is it only one of them?) with the tragedy of Donkin and the conquest of Mummery. Therefore, firstly, let us find out the surest names from the beginning or give a number; and, secondly, let not the new-comer be too eager to "correct" well-established landmarks of recognized pioneers. If the pioneers know their duty to what is beautiful in geography—science need not be pedantry—they will avoid the bad taste of enlarging the dreary topographic edition of "Who's Who," or remind themselves of that Gargantuan *testimonium paupertatis* of human imagination, a list of American towns. Even in uninhabited regions the language of the nearest tribes (Eskimo, Waganda, Maori) might be used to coin short and pithy fancy names that do not clash with local colour.

With our view from the Laudan pass we may combine a short sketch of the geology of the district. I quote from the report of my dear friend Albrecht von Krafft, whose death in the service of the Geological Survey of India is still lamented by all who knew him. He passed through here on a rapid journey from Karatagh to Kshtut, and was only able to gather some of the more prominent facts. To his vivid description of the mighty peaks I owed my resolve to visit the Fan region as soon as possible. He says, "The northern slope of the Hazrat Sultan Alps (*i.e.* that branch of the Hissar range with which we are concerned) is far richer in sedimentary formations than the southern side. Near Saratagh begins the red and grey dolomite, the black limestone and calcareous limestone, which have a thickness of over 3000 feet. These masses of dolomite and lime reach to the northern foot of the chain, and all the great summits are formed out of them. Between the stocks of dolomite, the substratum, composed of phyllites, is occasionally laid bare. Dislocations traverse the district, so that the lower horizon of the limestones

* Perhaps some day the author of a map for tourists will print on the margin the most important facts in the history of the map—previous maps, etymology, doubtful points, references to books, etc.

is found at different heights. Margusar is in the midst of a dolomitic landscape, whereas the Laudan pass cuts into phyllites." *

Next day, on July 29, we made an attempt on Vashan Tagh, but were repulsed by an accident which befel me 200 feet below the top. I was struck by a stone, and had to be bandaged. To mention it at once, we also tried Khon Tagh a few days later, but had to retire.

Near our camp my wife and I had a somewhat dangerous encounter with two shepherds and three dogs, whom I was able to keep from mischief by a little diplomacy. Attacks on Europeans are exceedingly rare in Russian Turkestan, which may be said to be one of the safest countries in the world for the traveller. We had just been to a point of vantage above our Laudan camp, and from there had seen the deep valley of the Pasrud sources. Its wild loneliness gave hopes of interesting discoveries, and accordingly our tent was transposed to the Lailak Chapdara, as its occupiers called it. The flat space on which these summer huts are found (invisible on the photo because hidden away on the extreme right) is on the upper Pasrud at about 8000 feet. As soon as we step on this platform there is a transformation scene which brings us into Scotland.

It is one of the rare sanctuaries which the water-nymphs have been able to hide away in the arid stone-pit of the gods of the Duab. The grassy glade, swampy in parts, is strewn with lichen-covered blocks, between which flow shallow brooks of clear cold water amid banks and islands of beautiful flowers. Dark groves of thuyas surround the clearing on the level, which represents the last and lowest step of this morainic scenery, which rises towards the background in a series of gradients, forming a tasteful transition to the rocky wastes beyond. My photographs should describe better than any words the intimate charm of the moorland glen near our camp, where nature was allowed to show herself as a landscape-gardener of sweeter mood. Why does she wear this kindlier face? Because here the ground "holds water;" it is soaked with water, not merely traversed by a ditch. Old moraines have been left across the valley in waves and heaps; great falls of rock from the precipices have added their share. In the bowls and pans thus formed the glacier-water has accumulated, held back by the grit and clay in the moraines, or by the fine material which it had itself carried down and deposited in the clefts of the lower dams of loose boulders.

The latter process works from bottom to top, which explains that we find the more finished landscape on the lowest step. The site of Lailak Chapdara must have been a (shallow) lake, which gradually was filled up and changed into a bog and then luxuriant moor. It represents the last filtering of the glacier-stream; but hardly has it left this place of

* He calls the Laudan pass "Lailak;" Kossiakoff knew it as Rasi-Rabat.

purification, of peace, and beauty than it hurries on to join the common rush, and, like a reckless youth, throws itself into the troubled career of the Surkhab, which is full of mud.

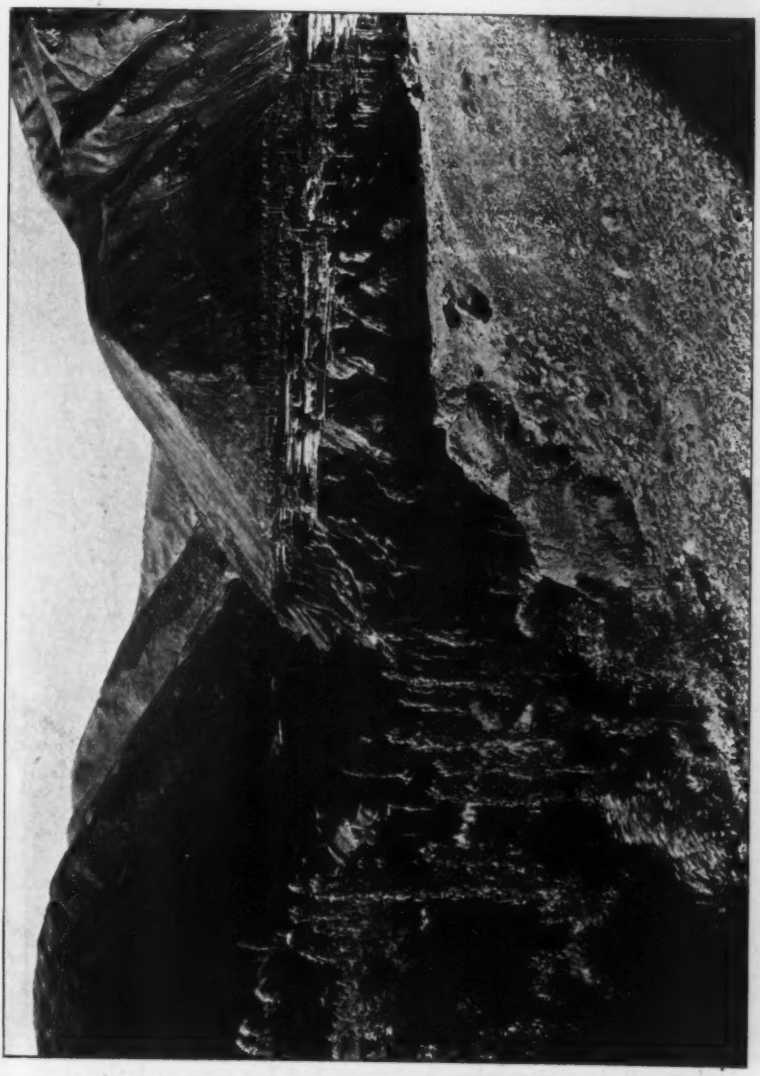
Let us find the source of the Pasrud. We go through a thick forest where some of the dark trees are hung with branches of lovely roses. After a climb of about 300 feet we discover the first lake (No. 1), a shallow mossy tarn lying in deep shade below the sheer wall of Khontagh, garishly illuminated by the sinking sun. It receives and discharges visible streams. A hundred feet above it we meet three strong Pasrud sources which run down to supply the two rivulets which embrace the Lailak. Another 300 feet or so and we stand on the grand piles of tumbled blocks that make the lower shore of the largest lake (No. 3). Here we are in surroundings of a sterner character, reflected in the sombre waters over which the near mountains cast their gloom. When the light of midday brightens it, we can revel in shades of blue and green from the rich sapphire of the depths to the gay emerald of the algæ in the shallows near the shore.

To make our report quite accurate, let us also enumerate lake No. 2, which lies in a clean stony bed held between the sharp-angled screes of a recent landslide and a hump of moraine. It has no visible outlet, but receives the left and weaker branch of an open escape from the great lake. The right prong of this forked stream only sees daylight for 30 yards, and then sinks away. Attempting thus to trace the surface streams, we have obtained an insight into the complicated hide-and-seek of the waters. Some of it leaves the big lake ostentatiously and dives away suddenly or in the wider surface of a pool; some of it thrusts itself forward from underground.

Valleywards the big lake is fenced off by a ridge of rocks rising to 60 feet above its plane. Towards the interior is a moraine-dyke 200 feet high and spotted with stunted thuyas. Tracing an inlet at the eastern corner, we proceed on our search. Like a noble queen, the torchweed raises its golden sceptre above a host of tenderer plants that have already gone to rest, for we are now leaving behind the oozing sponge, that honeycomb of moisture between the great lake and the Lailak camp. Behind the dyke just mentioned the wanderer will march across a sort of irregular swelling, half a mile wide and long, which is also the width of the valley. This gentle rise is covered with numerous mounds or round heaps of astounding regularity. Small trees still flourish, and in a hollow near the screes on the right side is a colony of aspen. Near by shines a mirror, to which the stream, still above earth, will guide us. The floor of this lakelet is a grand sight to see. It gleams and glitters with the many hues and the brilliancy of a faultless opal. No more can I say; it is the truth.

Onward now to reach the higher and blacker dumps of the retired ice. Passing over a scree-fan from Khon Tagh, we imagine ourselves

walking on billiard-balls, so rounded are the edges of the stones, and that only from dry grinding. The stream, which is getting thinner and



IN THE ZARAFSHAN VALLEY.

thinner from constant losses, here issues from a spring amidst a waste of sharp-angled and striated limestones of many tints. Then a low

rampart, and then a very high one, dark, forbidding, crowned with a titan-boulder that hails us from afar. Between these two moraine waves is a lake, a basin of thick black ink in a hollow of ashen shingles. It is fed by a spurt issuing from the coarse rubbish-heap in front. There sprout a few long grasses, fading wolfsbane, and the stalks of the sorrel with their red, green-edged seed-vessels.

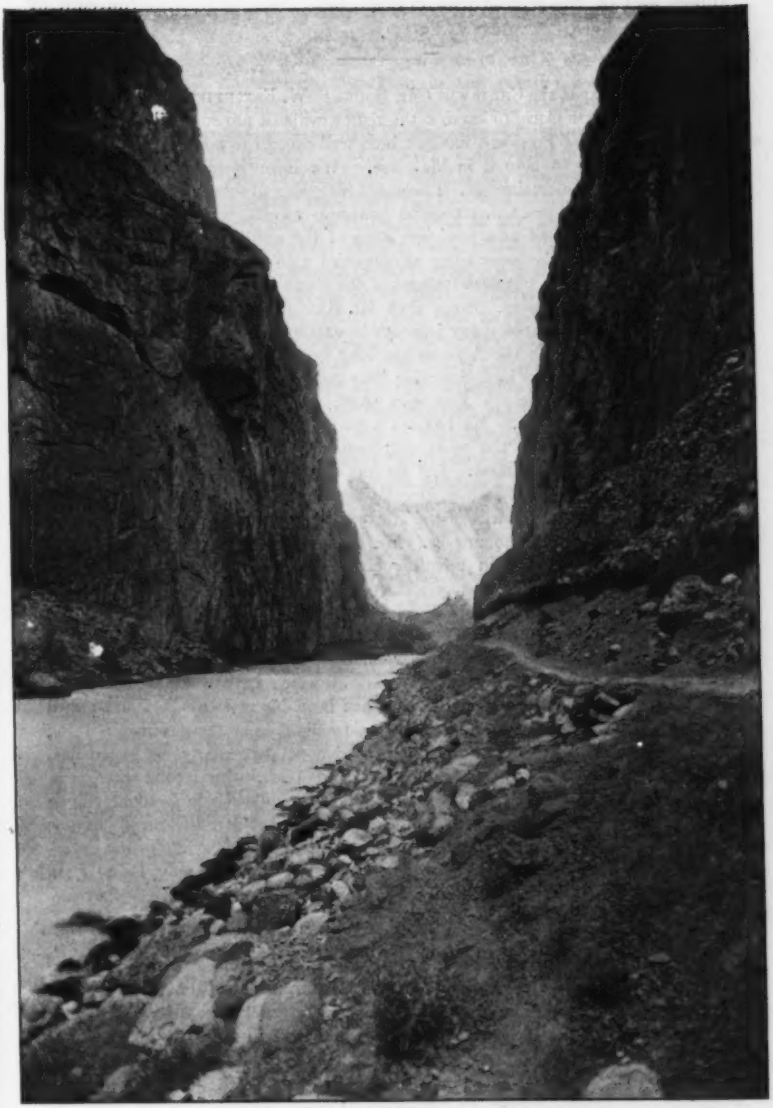
Hence we do not see water for a long time, but have to climb patiently for many hours over what may be described as a gigantic cataract of blocks disgorged into the narrow trench between the mountain-sides, a veritable pandemonium of broken stone. To our left we obtain a glimpse of the south-eastern aspect of Khon Tagh, an interminable flight of moraines and screes without a single speck of snow. Nothing but loose rubble, on which next day we spent six hours of steady plodding. In a moister climate, even under the same latitude, there would surely be *névé*.

At last we reach our goal at a height of 12,000 feet. We stand on comparatively level ground in the focus of a magnificent panorama of glacier peaks. Before us a grey lake. Its opposite shore is a gravel delta covered with a network of countless channels. On our side is a miniature Norway, formed by the labyrinthine rocks that fall away into fjords of deep water.

From the gullies of Chapdara descend the twin glaciers, the sources of the Pasrud. Their waters unite in the glacier-lake, secrete themselves in the block caves of its lower coast, and there begin their fanciful journey to the world below. The chaos of stone, of mountains firm and mountains shattered, is but thinly hung with that mantle of snow and lacework of ice which so royally clothes the shoulders of Swiss and Caucasian monarchs. My general impression is, taking things all round, that thickness and extent of the *névé* seems very poor, which indicates that the scorching breath of the desert is also here. Seeing what I see here, I am not so sure that a covering of snow and ice has not a preservative effect as contrasted with the weathering of the naked ribs of the Duab.

But of course these are second thoughts, the outcome of reflection that compares, not of immediate vision. This means that the effect of climate on the view begins to pale before a wider influence. Vegetation we do not expect in any case; the most familiar factor of comparison is ruled out, and that makes the lofty mountains of the world akin. Two things only are seen—rock and snow. Therefore the landscape is truly Alpine, a cloudless day in a high limestone range.

We know that the great snow-domes as seen from the valley present the same appearance at all seasons, and if we let our thoughts soar higher still, to regions where no human foot has gone, or higher yet, where even mountains but aspire, there may be said to be a realm of air beyond all climates and all seasons, like the bottom of the sea.



GORGE OF THE FAN ABOVE PITI.

There the shifting scenes of desert and garden, of the battle of the stones and of the wind-borne crystal, fade and merge into the cold of the outer sphere.

Before the paper, the CHAIRMAN (Mr. DOUGLAS W. FRESHFIELD, Vice-President): I have, in the first place, to express the regret, which I am sure will be shared by all present, that our President has not been well enough to take the chair to-night. He has asked me to take it in his place. We have to-night two travellers * present—a double entertainment. I need not introduce to this meeting Mr. Rickmer Rickmers. Many of you will remember that nearly eight years ago, in November, 1899, Mr. Rickmers read us a paper on some of the results of his journeys in the province of Bokhara, the paper being accompanied with many excellent photographs which illustrated those physical features of the Earth in the investigation of which he has taken so much pains. Since then Mr. Rickmers, accompanied as a rule by his intrepid wife, has made many journeys in various mountainous regions both in Europe and Asia. With the Alps he has long been familiar; he has been one of the principal instruments in introducing into them that practice of ski-ing which has now become not only a European sport, but in the French and Italian armies a military exercise. He has led a party into the heart of the Caucasus, which accomplished there the most extraordinary feats of mountaineering, and he has ascended Mount Ararat. But he has devoted himself more especially to the exploration of the region which he calls the Duab, the mountain cradle of the Oxus and the Yaxartes, a district of the greatest interest, not only to the geographer, but to the student of the human race. Mr. Rickmers is more than what is sometimes called with contempt in scientific circles a mere mountaineer. He is a skilled observer and student of physical geography, and from this point of view he hopes to devote several years to the investigation of the physical features and the glaciation of the mountainous regions of which Samarkand is the centre. As he means to reside in Samarkand for several months in the year, he will be most favourably situated for carrying out the work on which he has set his heart. In this work Mrs. Rickmers, who in the past has been his most devoted and useful assistant, means to co-operate, and I hope that to-night, as at the meeting in 1889, she will favour us with some of her own experiences, particularly her experience, say, at a height of 20,000 feet above the level of the sea. Our second traveller is M. Borisoff, a Russian artist, who is now holding an exhibition in London. Since we have already had a discussion of the scientific results of Mr. Rickmers' journey at a recent Research Meeting, the slides taken from M. Borisoff's interesting drawings will be shown on the screen after Mr. Rickmers' paper. I may, before I sit down, point out that our visitors to-night are linked by a common object—they are both lovers of the regions of ice and snow. M. Borisoff, it is true, takes his ice and snow in allopathic doses in the polar regions, whilst Mr. Rickmers, like myself, takes his homœopathically in those silver heights which rise "islanded in the immeasurable air" above the pines of the temperate zones or the palms of the tropics. There is yet one more link between the two travellers—both have travelled within the limits of the Russian dominions. I am glad to have this opportunity formally to acknowledge, both on my own behalf and on that of this Society, the

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* M. Borisoff, a Russian artist, who has spent some years in Novaya Zemlya and the Samoyede country, exhibited a series of slides reproduced from his pictures of Arctic scenery and life.

constant courtesy and the great facilities which have always been extended by the Russian Government to all properly accredited scientific travellers of whatever nationality. I have myself profited by these facilities in the Caucasus in the course of three journeys. I not only was given every practical aid in travelling, but I was allowed to use all the Government surveys, some of which were not published. I was even allowed the surveys that were in the making, sometimes still in manuscript, and it was entirely owing to these facilities that eleven years ago I was able to give the public of Western Europe the first authentic map of the glaciers of the Central Caucasus. And, turning to an earlier period, when I was one of the Hon. Secretaries of this Society, I had many occasions to observe how English travellers penetrating into further Asia were helped by the Russian Government. I will only cite one instance, that of Mr. and Mrs. Littledale in the very remarkable journey that brought them almost to the gates of Lhasa. In that journey they started from a Russian base. We geographers and men of science are indebted to the Russian Government for having recognized that it is not to the advantage of a great and civilized state to place obstacles in the way of the pursuit and progress of geographical knowledge; but that, on the contrary, such a policy would be unworthy of a wise and philosophical and liberal-minded statesman. I will now call upon Mr. Rickmers to read his paper.

After the paper, the CHAIRMAN: Although we shall not have time for any discussion, I am sure we should all like to hear any observations Mrs. Rickmers may have to make on the paper we have just listened to.

Mrs. RICKMERS: I remember on the last occasion I had the honour of speaking here I discussed the hardships of such a journey from a woman's point of view. I need not, therefore, dwell on that side of the subject again except to say that I never am so well as when engaged in travel of this sort, and the eight years which have intervened since the last occasion have in no wise diminished my capacity for enduring the hardships of such a journey. I look upon it, in fact, as a kind of rest cure for the nerve exhaustion induced by Western civilization. My husband has spoken of the help we gave him in taking the photographs, but there is another side of our activity which he has left unnoticed—I refer to our administrations to the lame, the halt, and the blind in season and out of season. We undoubtedly relieved him of a considerable amount of work in this direction, for whereas he was in the habit of recommending an application of brilliantine for all sorts of ailments, we really attempted some diagnosis of the cases brought to us, and nothing could exceed the kindness and skill with which we anointed and bound the poor sufferers wounds. The inhabitants of Bokhara are apparently far less susceptible to germs than a more highly civilized people, and I may say that our suggestion to one that he should bathe his eyes was rejected with contempt, though the doctor at the hospital gave him the same advice, which, let us hope, made more impression. The chairman asked me to tell you of our journey to a height of 20,000 feet. In the last half-hour was concentrated the greatest physical discomfort I have ever experienced. My hands and feet were numbed, and from the summit there blew such a breeze of icy coldness, that, as I say, I was absolutely miserable. It may be a fine thing to be at a height of 20,000 feet, but I felt very glad when we turned back.

The CHAIRMAN: I have now to introduce to you our second traveller, M. Borisoff, a distinguished Russian artist. M. Borisoff has had a most interesting career. Brought up amid peasant surroundings, at the age of fifteen he was sent by his parents on a pilgrimage to the Solovetsky monastery on the White Sea to return thanks for his recovery from illness. There he fell in love with the Arctic Regions, and shortly afterwards developed a passion for art. To gratify these tastes, he

returned to the monastery at the age of eighteen, I believe without the knowledge of his parents, and worked in the shop attached to it in the production of the sacred pictures and icons which you see all over Russia. A Grand Duke fortunately came that way, and recognizing the artistic talents of the youth, provided for his artistic education at the Academy of St. Petersburg. After that his career was decided by the patronage he received from Count Wittwe and the members of the Imperial family. He obtained the means to go and study his subject in the Arctic Regions. He set out in a yacht and sailed about the coasts of Novaya Zemlya, and thus gratified his ambition to become the painter of the Arctic Regions, as M. Loppé is the painter of the High Alps. And now we are able to look on reproductions of many of his realistic and very accurate sketches or impressions of the regions of snow and ice, of the tundras of the far north and the shores of Novaya Zemlya. I only regret that, as he does not speak English, he will not be able to explain them, or give the names of them, himself, therefore if I fail in giving them from this list, I hope you will excuse me. These slides are all taken from paintings made by M. Borisoff, and I am told they are taken by the three-colour process.

[The slides were then exhibited, Mr. Freshfield giving the explanations.]

The CHAIRMAN: That brings to a conclusion the series of slides M. Borisoff has been good enough to bring here, and I am sure you will all agree with me in according a very hearty vote of thanks both to Mr. and Mrs. Rickmers and to M. Borisoff for the instruction they have given us this evening. I think there can be but few meetings at which we have had a more continuous and richer entertainment than has been afforded us to-night.

The following discussion took place at the meeting of the Research Department:—

Dr. STRAHAN: This has been an extremely instructive series of slides, and I am glad to have had the opportunity of seeing them. The evidences of former glaciation on a much larger scale than that of the present day have been brought out in a most remarkable manner by these views of moraines. I was especially struck by the manner in which the morainic material may be spread out in the form of a flat bottom to the valley. It has long been a puzzle to me to know in what form the ice last lingered in our valleys in England, and more especially in Wales and Scotland, and where the last remnant of the sheet was situated before it dwindled away to nothing. So far as regards terminal moraines of valley-glaciers, we have none, except perhaps in our most mountainous regions; over a great part of the country we have none. But we have enormous flat stretches of gravel along valleys, as well as a tumultuous deposit of gravel which is not confined to valleys. Anything that will throw light on the distribution of these in our country is greatly to be desired. But I have accepted your invitation to speak merely for the purpose of expressing the great pleasure with which I have seen these photographs.

Mr. DOUGLAS FRESHFIELD: Mr. Rickmers' treatment of his subject this afternoon has been too geological for me to make any remarks that would be of value. The first impression the photographs give to one who has seen many mountains, is that from a picturesque point of view the region under notice is hideous. But mountains denuded of protective vegetation may be extraordinarily instructive from the geological point of view. The only mountains I have seen denuded and torn in this way by water-action are those in North-Western Persia, on the Araxes. With regard to the views on the Zarafshan glacier, the pocket-lakes in the ice reminded me of the glaciers of Kanchenjunga, the lower portion of which corresponds with the description given by Mr. Rickmers of Central Asian glaciers. With regard to the retreat of the ice, that of course is another proof that a retreat of the

ice has been going on all over the globe during the last fifty years. How great it has been in the Alps, there are few who can realize better than I can. I saw the Swiss glaciers when I was a child, and the retreat in many cases must have been over a mile. As to the character of the surface left after a glacier has retreated, I think perhaps the finest example in Central Europe must be that at the lower end of the valley of Aosta, where the enormous moraine of the old glacier of Mont Blanc protrudes in a great mound for some 12 miles beyond the Alpine foothills, enclosing an area somewhat higher in level than the rest of the Piedmontese plain. For any one who wants to study the work of a prehistoric glacier, there is no better place in Europe than the neighbourhood of Ivrea.

Prof. Watts: There is not very much that I can say except to congratulate the Department on the marvellous and most interesting series of views that it has had an opportunity of seeing. Those who have had a large experience in dealing with geological and geographical photographs will have found how difficult it is to secure such points of view as will show large features on the scale on which Mr. Rickmers has succeeded in showing them. In the abstract of the paper he modestly disclaims doing anything more than collecting facts for others to deal with; but I am sure every one here will agree that it requires no mean skill to have not only selected the points of view, but to have explained so many of the difficulties encountered. To me, as a geologist, the photographs open one's eyes to very grave difficulties. In this region there is very rapid denudation going on, more rapid than would be expected *à priori* in such a dry climate; and in consequence a great number of deposits of different characters are being laid down, moraines at one point, alluvial at others, solidified mud-streams and shoot-cones, as well as the ordinary screes, gravels, and wind-drift. Now, we have in parts of England old rocky landscapes filled up and coated over with deposits of a similar nature. The Permian breccias are somewhat like screes, the pebble-beds like old shoot-cones, and the other deposits shown to us are more or less like members of the Trias; but what is brought out by this paper is the complex relationship of deposits which must exist under those smooth coatings of Trias which form the floor of the Midland Counties.

Sir Martin Conway: There are only two points that I think I might refer to in connection with this very interesting series of slides we have seen and the remarks made. The first is about the surface of the glacier referred to, and its similarity to that of the big glacier of Kinchenjunga. It exactly resembles the two great glaciers of the Hispar and the Baltoro—the same great pools, with the steep sides leading down into them, and the endless succession of them, and the enormously thick load of moraine all over the surface of the ice. I was particularly interested by what I think any traveller in those regions must notice who pays attention to causes and effects—the enormous development of the mud-avalanches in those parts. The mud-avalanches in Mr. Rickmers' country do not seem to have attained so great a development as they do south of the main range. Where I was, all through Nagar and Hunza, the mud-avalanche is by far the most important agent in forming the miscellaneous deposits you meet with in the valleys. The moraines, even though enormous, are secondary, and are not so big as the enormous deposits produced by mud-avalanches. These mud-avalanches do not come at odd times; they have their definite periods; practically all of them fall within a fortnight; they are not produced by rain, but by the melting of the winter snow. Probably those I saw were larger than those Mr. Rickmers saw. I was present one day when some 150 of them fell, over a single broad hillside; and I could see that hillside from bottom to top, from the bottom where it reached the rapid Nagar river, away up to the top where it was above the snow-line, a vast slope of rock seamed by an infinite number of

gullies, and about 10,000 feet in height. The snow was melting very rapidly all over the upper surface; water was trickling and pouring down every one of its little upper gullies, which were very numerous. These gullies run together, like the branches of a leaf, uniting to form a few main gullies down below. Down these gullies all day long the mud-avalanches were being discharged, and they came down in a puzzling fashion. I stood by one of these gullies for more than an hour, —and five avalanches passed. Each took about five minutes to go by. I measured the size of the gully and the amount discharged, as well as I could, and recorded it in my book at that time. They started at the top as very little falls, and then by the mixing of the water and the snow with the *debris* that they picked up on the way, and the rocks and rubbish that fell into them, formed a little dam in the gully, and behind that dam the stuff collected till it burst the dam. Then the thing fell further, and clogged and formed a dam lower down, so that there was a continual formation of dams and bursting through of them, and each time the stuff collected it was larger in amount in proportion as it was formed lower down. I saw one of these dams formed and burst quite low down, and the amount of stuff that was held back, and then the enormous discharge that came when the dam burst, enabled me to judge of what was possible in that way. The sides of the gullies in this case were constantly falling in, not falling out, and pieces of rock, 6-feet cubes and larger, were carried down as though they were corks in this stuff. They rolled over and over, and fell at last into the bottom of the river below. For a day or two after that, we passed along the foot of what I may call, roughly, parallel gullies cut more or less in the same long range of mountains, and down every one of them we saw the traces, not yet dry, of mud-avalanches that must have fallen about the same time, so I take it that where we were, in the Hispar valley, and on the other side of the mountains (for we found, a few weeks later, that traces of mud-avalanches were plentiful there), somewhere about that time, which I think was early in July, these mud-avalanches were being discharged over the whole district, and the volume of *debris* that they must have brought down in the fortnight was enormous, far greater in proportion than anything carried by the glacier in a similar length of time.

Sir Henry Trotter: I am afraid I have nothing to say on the geology of the subject, but perhaps I may make allusion to the most excellent and realistic photographs which have been shown to us, and which reminded me very much of what I saw myself some thirty years ago in Tibet and in the Pamirs; I seemed to find myself at home at almost every step. I only mention this as a tribute to the excellence of the photographs. As regards the mud-avalanches, I may say that the pictures forcibly reminded me of what I saw only a few weeks ago in the neighbourhood of Naples. The plain was covered with snow, out of which protruded a narrow, dark, and tortuous stream of large blocks of lava, the outcome of the last eruption of Mount Vesuvius—and resembling in appearance, and somewhat in character, the mud-avalanches which have been so accurately described by the last speaker.

The Chairman: I think you will agree with me, gentlemen, that we owe a very hearty vote of thanks to Mr. Rickmers for the very excellent lecture he has given us, and especially, if I may say so, for the excellent lantern slides. I hope next time he comes back he will give us slides prepared on the three-colour process, which, I am sure, would be extremely interesting. I ask you to pass a hearty vote of thanks to Mr. Rickmers.

DR. STEIN'S EXPEDITION IN CENTRAL ASIA.*

After despatching from Abdal a caravan to Kashgar with most of the archæological "finds" brought away from the ancient sites north and south of Lop-nor, I started in the last week of February towards the oasis of Sha-chou, better known by its old name of Tun-huang, on the westernmost border of the Chinese province of Kan-su. The route taken by us through intervening desert may claim special historical interest. It was the same which Marco Polo had followed, and by which, six centuries earlier, Hsüan-tsang, the great Buddhist pilgrim, had made his way back to China from Lou-lan, the present Charklik. Ever since the second century B.C., when the Chinese first extended their influence into Turkestan, this desolate desert track, close on 350 miles in length, had been an important caravan road during successive periods of their supremacy in the Tarim basin. Yet for centuries past it had been almost completely forgotten. Rediscovered some twenty-five years ago, it is just now coming rapidly into favour again with traders from Khotan and Kashgar, probably as a result of the commercial tide attending the increased prosperity of the oases in the south of the great Turkestan desert. It was interesting to note that a large part of the goods which those enterprising pioneers import by this ancient road to Cathay, consists of English fabrics brought all the way from Kashmir on pack-animals. Marco Polo's description of the route was found thoroughly accurate in all its topographical details. But with men and beasts accustomed by the winter's work to even more forbidding ground, we managed, in spite of the trouble arising from salty springs and scanty grazing, to cover the distance, which he reckoned at twenty-eight marches, in seventeen, with two days added for halts.

The ground traversed proved of considerable and varied geographical interest. For more than one-third of the route we were skirting the shores of a vast salt-covered lake-bed, indicating the extent of the Lop-nor marshes at a period, perhaps, not very remote. Beyond, the detailed survey carried along the route by Surveyor Rai Ram Singh showed clearly that the well-marked depression between the slopes of the Kuruk-tagh and the Altyn-tagh in which we moved had once served for the passage of the waters of the Su-le-ho and Tun-huang rivers down to the Lop-nor. Where this valley expands eastwards we came upon ground very puzzling at first sight, not only to the traveller, who runs a risk of losing his track here with ease and serious consequences, but also to the topographer. Surrounded to the south by high ranges of dunes, and to the north by the absolutely barren gravel slopes of the Kuruk-tagh, there extends a wide basin containing unmistakable dry

* Communication from Dr. M. A. Stein, dated "An-shi, Kansu, June 18, 1907."

lake-beds, and between and around them a perfect maze of high clay terraces remarkably steep. The lake-beds, salt-covered in part, looked distinctly recent. Yet the lake, shown as Khara-nor in the maps, in which the Su-le-ho and Tun-huang rivers were hitherto supposed to end, and from which alone sufficient water could come to fill this great basin even temporarily, lay still fuller a degree to the east. It was only in the course of the subsequently resumed surveys that we discovered that a considerable river flows out of the Khara-nor during the time of the spring and early summer floods, and, after draining some smaller lakes and marshes lower down, carries its waters nearly 60 miles further west into the desert. The very deceptive way in which its deep-cut bed and earlier, now dry river channels are masked by what looks an unbroken flat glacis of gravel, accounts for the error of former maps. The curious clay terraces proved to have their exact counterpart in formations found about the shores of the Khara-nor, and probably due to the successive action of water and wind erosion.

It was soon after emerging from this great depression at a point still five long marches from the edge of the Tun-huang oasis, that we came upon remains of ruined watch-towers and an ancient wall, or *agger*, connecting them. A variety of archæological indications, rapidly gathered as we passed along them, convinced me that they belonged to an ancient system of frontier defence corresponding to the extant "Great Wall" on the Kan-su border. The wish to explore it in detail induced me to return in the second half of March to the still wintry desert as soon as men and animals had recovered, by a short halt at Tun-huang, from the fatigues and exposure of the preceding journey. By moving first to the north of the oasis, and subsequently striking the ancient *limes* by a new route through the desert west of Tun-huang, we succeeded in accurately surveying its line right through for a distance of some 140 miles, and exploring the ruins of its watch stations, sectional headquarters, magazines, etc. From the Chinese records, mostly on wood or bamboo, which the excavation of almost every ruin yielded in plenty, I was soon able, with the help of my indefatigable and scholarly Chinese assistant, Chiang-sieh, to make certain that this frontier line was constructed at the close of the second century B.C. under the emperor Wu-li, who commenced Chinese expansion into Central Asia. It appears to have remained regularly garrisoned down to the middle of the second century A.D. Dated documents are particularly numerous from 98 B.C. to about 25 A.D., the time when a period of internal and external troubles came to an end with the advent of the second Han dynasty. There can be no doubt that the main purpose of the *limes* was to guard the territory south of the Su-le-ho river, which was indispensable as a base and passage for the Chinese military forces, political missions, etc., sent to extend and consolidate Chinese influence in the Tarim basin and further west. The enemy whose attacks had to be warded off were the Hsiong-

nu, the ancestors of those Huns who some centuries later threatened Rome and Byzance.

In the west we traced the fortified *limes* to its very end where, after a great bend to the south-west, its flank rested secure on extensive salt marshes and equally impassable mountain-like ranges of drift sand. Eastwards I could follow its line to the oasis of An-shi, from where it is likely to have extended to the present Kia-yü-kuan gate of the "Great Wall." The fact that almost the whole of the line from An-shi to the west passed through what was already in ancient times an absolute desert, broken only at intervals by belts of scrub and thin jungle near the rivers or marshes, has, no doubt, helped to save the ruins from destruction, such as always threatens remains in inhabited areas. But a still greater share in the remarkably good preservation of the antiques excavated, and of structures showing but little apparent strength in their materials, must be ascribed to exceptionally favourable conditions in the climate and soil of this desert. The latter can have seen but extremely scanty rainfall for the last two thousand years, and in most places but little erosion by driving sand; for the hundreds of inscribed pieces of wood, bamboo, silk, and the mass of miscellaneous antiques had survived almost uninjured even where covered only by the thinnest layer of gravel or *débris*. Sometimes a mere scraping on the surface sufficed to lay bare files of records thrown out before the time of Christ from the office of some military commander on to a rubbish heap, in which even the most perishable remains, straw, fragments of clothing, etc., looked perfectly fresh.

The Chinese documents, of which close on two thousand were recovered, refer largely to matters of military administration, often giving exact details as to the strength, movements, etc., of the various corps distributed along the border; arrangements about their supplies, equipment, etc. Others are private letters addressed to officers, full of quaint actualities, etc., or official reports. Together with the remains of the quarters, furniture, arms, etc., excavated, they will amply suffice to restore a picture of the life once led along this most desolate of borders. One of the best preserved ruins is that of an imposing magazine, forming a solid block of halls nearly 500 feet long. Apart from the Chinese records, I recovered very interesting relics of the traffic from the west once passing along the line guarded by the *limes*, in the form of silk pieces inscribed with Indian, Brahmi, and Kharoshthi, and in a number of letters found carefully fastened, containing writing in an early Aramaic script but possibly Iranian language. Most of these turned up along with the Chinese records of the time of Christ. Can they have been left behind by early traders from Persia or Western Turkestan coming for the silk of the distant *Seres*?

These explorations, which kept us busy well into May, had for me the special attraction of combining geographical and archæological

interest. Desiccation within historical times, on which Mr. Huntington's recent investigations in Turkestan have thrown so much fresh light, has left quite as distinct traces in the Tun-huang region as throughout the southern part of the Tarim basin. We could scarcely wish for a more accurate gauge by which to estimate the extent of the physical change that has thus taken place in this part of Asia within exact chronological limits, than this border-line drawn through the desert by Chinese engineers in the closing years of the second century B.C. The ground it traverses has remained wholly untouched by the manifold and often complex factors connected with human activity in the shape of irrigation, etc., which affect inhabited areas, and there is plenty of evidence to show that those who laid down the line, selected the positions for watch-stations, etc., had been guided by a sharp eye for all surface features and their practical advantages. By closely studying their work, a great mass of important observations could be gathered. In the many places where the flanks of wall sections rested on marshes or small lakes, it was easy to ascertain the fall in the water-level, distinctive enough, but nowhere excessive. The materials which had been used in the construction of the *agger*, a rampart of gravel or clay cleverly strengthened by regular layers of fascines, afforded tangible evidence as to the vegetation then to be found along the various depressions. From the extent and character of the damage, due to wind-erosion, which the different sections of the wall, the watch-towers, etc., had suffered, definite conclusions could be drawn as to the force and prevailing direction of the winds which still blow over this desert with remarkable violence and persistence. Coming mainly from the east and north-east, they make their effort felt to a marked degree far away in the Tarim basin, as I have had ample occasion to observe in the climatic conditions and surface formations about Lop-nor.

We suffered a good deal from these daily gales and the extremes of the desert climate. Against the icy blasts, continuing well into April, our stoutest furs were no adequate protection. On April 1 I still registered a minimum temperature of 7° Fahr. Before the month was ended the heat and glare had become very trying, and whenever the winds ceased clouds of mosquitoes and other insects would come forth from the marshes near which we had to camp for the sake of water, to torment man and beast. Scorpions also abounded. The salty water was another source of trouble. When the excavations were completed by the middle of May, it was time to return to the oasis. I never ceased to wonder how, under such conditions, we managed to the last our Chinese labourers at work, all opium-smokers, and of considerable *vis inertiæ* like most of the people of Tun-huang.

About the archæological labours which have kept me fully occupied since at old sites to the south of the oasis, the briefest reference must suffice for the present. At the Buddhist cave temples, known as the

"Halls of the Thousand Buddhas," they revealed a great series of fine frescoes and stucco sculptures, going back mainly to the eighth and tenth centuries of our era. Together with abundant other remains, they attest the highly flourishing condition which Buddhist art and studies, imported from India, both through Central Asian and Tibetan channels, had, from an early date, attained here on purely Chinese soil. The materials collected are so ample and varied, that they will require prolonged labour on the part of several specialists.

Everywhere about the oasis I was able to observe the far-reaching effects which the devastation and loss of population attending the last great Mohammedan rebellion have had on the cultivated area. Taking into account the prevailing physical conditions, it appears improbable that the lands then abandoned to the desert on the outskirts of the oasis, will ever fully be recovered again for human occupation. Again and again I came upon such ruins of recent date which drift-sand is steadily invading. There is more than one "old site" in formation here which might well be ear-marked—for the archæologist, say, of 4000 A.D.

I am now starting along the foot of the mountains towards Su-chou, from where I hope, if time and local conditions permit, to effect surveys, both along the Great Wall north of this corner of Kan-su and in the Nan-shan range southwards during the summer and early autumn.

[In a later letter, dated July 10, Dr. Stein writes—]

Since sending you the last account of my doings, I have been able to carry on interesting survey work in the Nan-shan ranges south of the An-shi and Yü-mên-hsien. It was very pleasant to get near the snows again. They are plentiful on the main range, which has peaks rising to 21,000 feet and more. We have taken many heights by mercurial barometer and clinometer, and I hope the mapping done will be of geographical value even after the labours of the Russians. The physical conditions prevailing on the successive plateaus by which the Nan-shan rises from the Su-le-ho basin offer many curious features explaining formations in the desert below. Near Chiao-tzü I surveyed an extensive old site deserted six or seven hundred years, which reproduces most strikingly the changes undergone by the ground about the ancient sites north of Lop-nor. The same powerfully erosive east wind has been and is still at work at these widely distant places.

THE COURSE OF THE UPPER IRAWADI.

By MALCOLM MACLAREN, D.Sc., F.G.S.

THE present note deals with changes of recent date, geologically speaking, in the course of that portion of the upper Irawadi that lies between the Confluence, marking the northern limit of British "administered

territory," and the village of Shwegu, some distance below Bhamo. This portion of the Irawadi, together with the lower reaches of its two great affluents, the Mali Hka and the 'Nmai Hka, uniting at the Confluence, were traversed during the cold season of 1905–6 by the present writer in the course of an examination of the auriferous alluvial deposits of Burma. The upper waters of the affluents in Hkamti Lŏng have been seen by two or three travellers, and have been crossed only by Prince Henri d'Orleans on his arduous journey from Tongking to Assam, and more recently by E. C. Young. To visit their lower reaches, even in the vicinity of the Confluence, necessitates the employment of a strongly armed escort, and no explorer has yet succeeded in reaching the Hkamti valley by way of these streams. So far as they were ascended on the present occasion they lie in a deeply dissected mountainous region, the stronghold of the truculent Kachins. The old river-terrace on the flat tongue formed by the junction of the two rivers at the Confluence, the deep, narrow valleys, and the numerous rapids, all indicate streams still engaged in deepening their beds, and at this stage full of virility. On the Mali Hka, the western affluent, long shallow reaches with fast-flowing waters alternate with pebbly rapids. This branch, therefore, presents no insurmountable obstacle to canoe traffic. The 'Nmai Hka, on the other hand, as indeed its Kachin name would indicate (*'Nmai*, "bad;" *Hka*, "water"), offers serious impediments. It flows over Miocene ash-beds, whose strata of unequal hardness, yielding most irregularly to corrosion, have produced dangerous bars with narrow and tortuous rock-bound channels, through which the whole volume of the river rushes.

From the Confluence, and after a preliminary bend near Lapé, the river flows south in a fairly straight line to Myitkyina. Its current is still too rapid to permit of the deposition of anything but coarse gravel, and since the valley is narrow a natural sluice is formed here. It is, therefore, in the heads of the long reaches and on the bars in this portion of the river that gold has been deposited and concentrated in sufficient quantities to warrant gold-dredging, an industry now being vigorously developed. At Myitkyina, the British administrative post farthest up the Irawadi, the river may be fairly said to have left the Kachin hills. Its channel immediately widens to some 800 yards, and from Myitkyina to Sinbo, 72 miles by river and only 48 in a straight line, the Irawadi has almost reached a temporary base-level, as, indeed, the figures themselves would indicate. Its valley bottom, only half a mile to a mile wide above Myitkyina, has broadened to 16 miles. Its deposits are no longer gravel, but fine sand and mud.

To the north-west of Myitkyina lies the Pidaung plain, a broad savannah covered with tall *kaing* grass, the haunt of gaur (*Bos gaurus*) and tsine (*Bos sondaicus*). Its origin is obscure, for there is now no stream running through it capable of cutting it out, or of

THE UPPER IRAWADI
to illustrate the paper by
Dr MALCOLM MACLAREN.
Nat. Scale 1:1,000,000 or 1 Inch = 15·78 Stat. Miles.
0
10
20
Heights in feet
97°
30°
Mali Hka
Confluence
Nmai Hka
Tara
Pidaung
Plain
Nanki Chaung
Irawadi
8589
5055
4440
1850
Myitkyina
Mogaung
1832
M Y I T K Y I N A
6234
8897
Burma Railway
Yinbat
Rapid
Mogaung R.
4185
4856
Former Bed of Irawadi
Sinbo
8970
Thetaw Lemd
Alaw Pum
5783
B H A M O
Elephant Rock
3034
Taipang R.
Mozit
Thittaung Ck.
BHAMO
361
6009
7011
Shwegu
R. IRAWADI
6263
Sinkan
97°

filling it when cut out, nor is it a filled oxbow of the Irawadi. It seems possible, however, that the Nanti Chaung, which now flows south-west to Mogaung and thence to the Irawadi, cut out the plain, possibly also assisted by the waters of the Mogaung Chaung itself, before their "capture" by a small stream at a point a couple of miles north-east of Mogaung station. The gorge-like character of the Mogaung Chaung at this place and its rapids near Yinbat lend some support to the view. The suggestion implies a partial reversal of the slope of the Nanti valley, but as the present divide between the head of the Nanti Chaung and the Pidaung plain is very low, and as the rock is an easily eroded sandstone, no great modification of present conditions is thereby demanded.

Turning again to the great river, a remarkable change in the nature of its valley takes place at Sinbo. It has all the way from Myitkyina been quietly meandering between low banks along a broad jungle-clad plain. A mile below Sinbo it plunges into the heart of the mountains, everything at this point, except the course of the waters, giving the impression of ascending rather than descending a valley. Half a mile wide in the plain, the river is now confined at the entrance to a channel no more than 50 yards wide. In the great floods of the "rains," the turmoil of the waters in the basin above the entrance is indescribable. Even at Sinbo, a mile back, the waters rise 80 and 100 feet above the low-water mark. It is related at Sinbo that they have been known to rise the former height in a single night. Once within the defile the channel broadens a little, and its average width for its length of 30 miles in the Third Defile may be taken at 150 yards. The "Gates" and the Elephant Rock are narrows, in the former case the width being only 50 yards. The general course of the channel is straight, but the valley ridges coming down to the water's edge with the *en échelon* disposition characteristic of the lateral valleys of virile streams, its course in detail is most tortuous, and sharp right-angled turns, yielding most exciting moments to the navigator, are by no means uncommon. The channel is rock-bound throughout the whole length of the defile, and is practicable for steamers only from November to April, the season of low water.

Twelve miles east of the great defile, and parallel with it for its total distance, is an open flat valley, 10 to 12 miles wide near Bhamo, and untenanted by any stream of consequence. East of Sinbo it is nearly as wide, and is there open to the broad Irawadi valley. Its levels are unknown, but there is no visible ridge at the head, and the divide, if one exists, can be only a few feet above the Irawadi level. From Alaw Pum (5783 feet), on the Yunnan frontier, and 28 miles north-east of Bhamo, the whole valley plain from Bhamo to Myitkyina appears absolutely level and unbroken. From that height the Irawadi may be seen to disappear near Sinbo, and instinctively but vainly the eye looks for its silver thread in the broad valley on the hither side of the Sinbo hills.

Yet it has obviously flowed along that valley at no very distant time. Why, then, has it deserted it to flow through mountains 2500 to 3500 feet high, and mountains composed, not of soft rocks, but of metamorphic schists? The answer is that the Irawadi waters have been "captured" by one of its own tributaries—a case, indeed, of "domestic piracy," to use the confused, but generally accepted, American phraseology.

An examination of the topographical features of the country of the Third Defile reveals the history of the capture. When the Irawadi in former days meandered peacefully beneath the Yunnan frontier hills, a tributary stretched from near Bhamo northward into the hills for a distance of some 30 miles. Beyond its head a stream flowed northward to join the Irawadi near Sinbo, as is shown by the general northerly direction of the tributary valleys. Near the Kachin village of Lema was the col. As both streams cut back their heads, the col was lowered until the waters of the Irawadi at high flood burst over it, and, hampered by the lack of grade due to the meanderings on its old flood-plain, gladly seized and deepened its new channel. It became, indeed, locally rejuvenated.

Below Bhamo also there have been changes, though none so striking as the foregoing, probably the most notable case of "domestic piracy" that modern rivers may show. Nine miles west of Bhamo is a broad gap in the hills, through which the Irawadi formerly flowed. It was at that time that the coarse gravels of the Mozit Chaung and Shwegu were deposited. The course of the old river-bed is now occupied by the Thittaung Chaung. Here again there appears to have been domestic piracy, though the evidence is far from being as conclusive as in the Third Defile. The waters of the broad Irawadi valley seem to have been tapped near Sinkan by a small tributary, and there resulted the Second Defile, neither so long, so grand, nor so dangerous as the Third, but infinitely more beautiful.

The movement of the Irawadi channel at the Third Defile has been westward. Seeing that Chindwin river, also meridional in its course, closely hugs the western edge of its valley and leaves a plain on the east, some support might here be obtained for Ferrell's theory of the westward tendency of river channels in the northern hemisphere, a tendency supposed to arise from the retardation of the waters due to the Earth's west-to-east rotation. That the movement of both should be in the same direction is merely a coincidence, for the Chindwin is certainly moving west with the dip of the Miocene sandstones, along the strike of which it flows. It affords, therefore, an example of "monoclinal shifting." In any case, either on the Chindwin or on the upper or lower courses of the Irawadi, lateral movement due to retardation cannot, as Gilbert long ago showed for another region, take place so long as the rivers are silt-laden, and of the rivers of the world the Irawadi is at the present time the second greatest silt-bearer.

THE VALLEYS OF THE HIMALAYAS.

By R. D. OLDHAM.

A RECENT number of *Petermanns Mitteilungen* is devoted to a contribution* to the study of the origin of the existing geography of the Himalayas by Dr. K. Oestreich, who accompanied Dr. and Mrs. Workman in their expedition to the Central Himalayas as topographer in 1902. The paper contains the record of many observations of interest, especially as regards the so-called plains of Deosai; his description and photographs of this district leave no doubt, in accepting his conclusions, that the existing relief must have originated at a much lower level than the present elevation of the region, which is characterized by broad open valleys and a comparatively small height of the intervening ridges of hills, and is in process of conversion to the deep-cut valleys and high hills of the outer Himalayas.

Besides giving an account of his observations, Dr. Oestreich devotes the concluding section of his paper to a discussion of the vexed question of the origin of the Himalayan drainage system, and gives a detailed account of what he conceives to be the history of its development. It would be unprofitable to discuss these views, which are necessarily speculative and merely a modification of those already published by others in detail, but a review of the present state of the question cannot be without profit, in view of the interest of the problem.

The two leading features to be explained are, firstly, the fact that two great rivers rise within a short distance of each other, on the northern side of the line of highest peaks, and, after flowing parallel to the range, turn abruptly to break through it and escape southwards as the Indus and Brahmaputra rivers. The second is the fact that most of the great rivers, flowing southwards from the Himalayas, rise to the north of the line of highest peaks and break through it in deep and narrow gorges.

The earliest explanation attributed the valleys to gaping fissures, opened by forces acting in the interior of the Earth; this explanation has been rejected and ignored ever since it was recognized that valleys are shaped, and often originated by causes acting on the surface of the Earth, but it contained an element of truth, inasmuch as it recognized that the course of a valley may be determined by causes acting from within. Leaving this explanation on one side, we have firstly the views of the late Mr. H. B. Medlicott, who was the first to establish, by actual observation, the fact that a river may be able, by cutting down its channel, to preserve its course across a rising range of hills. He applied this principle to the great river-valleys of the Himalayas,

* 'Die Täler des nordwestlichen Himalaya.' Beobachtungen und Studien von Dr. Karl Oestreich. *Petermanns Mitteilungen*, Erganzungsheft 155. Gotha, 1906.

which he regarded as relics of an earlier drainage system of rivers flowing from north to south across the Himalayan area, these rivers having cut down their valleys through the rising range, and continued to drain more or less of the country to the north of the main axis of elevation. The longitudinal valleys of the upper Indus and Sanpo were attributed to cutting back of the valleys of tributaries of these rivers along the strike of more easily removed rocks, whereby the transverse river-valleys were robbed of more or less of their upper waters.

As the interior of the range became better known, it was found that everywhere along the watershed there seemed to be evidence of its northward recession, and of an encroachment of the southern drainage area on the northern. This led to the promulgation of a fresh explanation, according to which the valleys of the upper Indus and Brahmaputra are structural, formed along a band of lesser upheaval, whose drainage escaped round the ends of the rising range in rivers which were able to preserve their course across the rising range in consequence of the volume of flow, resulting from the extent of their upper waters. Between these two cross-valleys the primitive watershed was regarded as having been practically coincident with the line of maximum upheaval, which again is that of the existing highest peaks; as the range grew in height, the difference in rainfall on its southern and northern slopes became more marked, the volume of the southward-flowing streams increased while that of the northward-flowing ones diminished, and the former began to cut back, till in some cases they were able to penetrate the main range and invade the territory previously occupied by the latter.

Our present knowledge of the interior of the Himalayas is not sufficient to enable us to balance these opposing explanations against each other, or to decide how far each has been the prevailing cause, yet some facts are known which suggest rather than establish the prevalence of one or the other. So far as the valleys of the upper Indus and Sanpo are concerned, we have the capital fact that the valleys of several of their principal tributaries join the main valley at an acute angle directed up-stream. This does not necessarily imply, though it very probably indicates, that these tributaries originally belonged to a different drainage system, and have been added to that which they now belong to by capture, that is to say, it is at first sight evidence of the truth of Mr. Medlicott's explanation. It does not, however, exclude the alternative one, for a large part of the area now occupied by the Himalayas must have been dry land at the time when they first began to rise as a mountain range, and this dry land must have possessed a drainage system, probably different from the existing one. The immediate cause of the alteration of this drainage into the two longitudinal valleys of the upper Indus and the Sanpo may have been cutting back and capture of the headwaters of other streams, the cutting back being in part controlled and directed by the occurrence of bands of easily removed rock, but it

may well have been directed and determined, in even larger degree, by the upheaval of the Himalayan range, which would raise a barrier across any rivers flowing from north to south, diminish their power of lowering their channels, and possibly, as has recently been suggested by Colonel Burrard, lead to their being dammed up and finding a fresh outlet to one side instead of along their original course. If this be the case, the longitudinal valleys would be as truly structural as if they had been originally determined by unequal movements of upheaval at the time when the Himalayan region first rose from the sea.

As regards the other rivers which traverse the main range, Dr. Oestreich rejects the explanation that the feature is due to cutting back through the original watershed; but his arguments, based on his observations in the Sind valley, do not seem valid. He calculates that if the levels of the outlets of the Sind and Suru rivers, into the Kashmir and Indus valley respectively, remain unaltered, the recession of the watershed cannot extend beyond some 12 miles or so from its present position, and, believing that the amount of recession which has taken place is only a mile or two, comes to the conclusion that the watershed must have remained, and will remain, pretty constant in its position. To this we may reply, firstly, that the assumptions cannot be granted, and, secondly, that if they were, the argument would prove nothing; of countless horses foaled each year, it would be easy to prove that any one could not possibly win the Derby, yet every year the race is run and won. The simile is, in fact, an apt one, for of all the foals born only a small proportion are ever entered for the race, a still smaller proportion reach the starting-post, and only one each year is added to the list of winners; and similarly on the south side of the Himalayas are countless valleys which have never had a chance of reaching the central range, a few have had the chance, but been distanced by their competitors, and still fewer have succeeded in reaching and penetrating the main range. The Sind river is probably one of those which has been outdistanced in the race, and will never have a chance of cutting back through the range of highest peaks to the valley of the upper Indus, but it does not follow that other and greater rivers, such as the Sutlej or the Kosi, have not been able to do so.

Leaving on one side, then, all arguments of an abstract nature, and coming to the consideration of the evidence there is for or against the explanation as applied to the valleys of the larger Himalayan rivers, we have, firstly, the fact that they traverse the main range in deep-cut narrow gorges, where the rivers are pent in narrow rocky channels. This suggests, though it does not prove, that the rivers have undergone a recent increase of volume, which may reasonably be explained by an increase in the area drained by their headwaters; and this, added to the evidence of recent recession of the actual watershed, suggests that the gorges are not relics of an older drainage, but due

to cutting back and capture, consequent on the steeper slope and heavier rainfall on the southern side of the range. The suggestion is strengthened by the fact that the feature to be explained is practically confined to the eastern half of the range, where the rainfall on the southern slopes is both actually and proportionately much greater than on the northern; here the headwaters of the southward-flowing rivers drain large areas to the north of the main line of snowy peaks, while west of the Sutlej, where the rain and snowfall become less unequally divided between the two sides of the main range, the watershed of the Indus drainage practically coincides with the main orographic axis of a line of highest peaks.

There remains one other point for consideration. It has been assumed, by all who have treated this problem in the past, that the original drainage of the Himalayan area was, as at present, from north to south; but there is no direct evidence that such was the case, and what indications we have point rather to the opposite conclusion. To the south of the Gangetic plain the peninsula of India is a fragment of a very old land surface; to the north of the Himalayas is an area which was sea through long geological periods; and when this sea was converted into dry land by the uplift of its bottom, the original drainage of the new land would naturally, though not necessarily, be from south to north and not in the reverse direction. If, as seems possible, this drainage still persisted when the elevation of the Himalayas began, it is evident that no part of the existing drainage system can be either "antecedent" or "superimposed," but all must be "subsequent," and the origin of the cross-valleys, of those rivers which rise to the north of the main lines of snowy peaks, must be looked for in the cutting back of their headwaters from the steeper and wetter side of the range. Certainly there are peculiarities in the courses of the Indus and Brahmaputra rivers, especially the very sharp angle at which they turn southward to cross the range, suggesting that this, after all, is the true explanation, and that the whole of the Himalayan area, which now drains to the Indian ocean and the Bay of Bengal, once drained off along channels whose courses are unknown, and have probably been obliterated by the great earth-movements of late tertiary and post-tertiary times.

Such is the present position of the problem. Nothing can be certain till the topography and the geology of the Himalayan region is better known, but if there is no certainty of the process by which the Himalayan drainage has been elaborated, it seems certain that it is due to a modification of an older and different drainage system. It is too soon to attempt to trace either the course of this earlier drainage or the history of its replacement by the existing valleys, but it seems clear that two factors have been important: firstly, the great differences in uplift of different parts of the range, and, secondly, the great difference

in the rainfall on its opposite sides. The relative importance of these two factors must have varied from time to time, and from place to place, detailed observations and study alone can decide which has been more important in each case, and the conclusions drawn from the study of one valley can hardly be applied to another, still less extended to a different and distant part of the range.

MR. CECIL CLEMENTI'S JOURNEY ACROSS SOUTHERN CHINA.*

An interesting journey across Southern China from east to west, in part by routes never before followed by a European, was made during the last three months of 1906 by Mr. Cecil Clementi, who carried out a route survey of most of the country traversed. This work was done with a prismatic compass, observations for latitude and time being also taken with a theodolite, while an aneroid was used for measurement of heights. The survey was plotted on the scale of one inch to the mile, covering three strips of tracing-paper with a total length of 15 yards. From these the map at the end of the present number has been constructed by the Society's draughtsman.

It will be seen that the route chosen by Mr. Clementi was of great interest, the middle part of it leading through one of the least known tracts of Southern China. The survey was begun at Hsün-chou-fu, at the confluence of the two main branches of the Si-chiang or West river, known respectively at the junction as the Pai Hoa or "North river," and the Yu-chiang or "Right river."† It was the latter which was followed by Mr. A. R. Colquhoun during his journey of 1882, and subsequently by a section of the French commercial mission to China sent out by the Lyons Chamber of Commerce under M. Brenier. The northern branch is in turn formed of two main components, the Hong-shue or "Red water" from the west, and the river of Liu-chou-fu—thought by M. Brenier to be the most important head-stream of the Si-chiang in point of volume—from the north. Its name, as given by Mr. Clementi, is Ching-shue ("Blue water"). This last river was traced by another section of the Lyonese mission, and also about the same time by Mr. Consul Bourne, in the journey undertaken on behalf of the Blackburn Chamber of Commerce. More recently it was ascended as far as Liu-chou-fu by M. François (cf. *Journal*, vol. 23, p. 518). Mr. Clementi ascended the North river to the junction of the upper branches, and then went overland to Lui-chou Fu, his further route

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* Map, p. 584.

† The name Hong-shue or Hong-shwei has usually been given to the northern branch, being the name of the arm which comes from the greatest distance.

taking him, in a generally west direction, past Ching-yuan Fu and various other towns, few of them marked in ordinary maps, to Yün-nan Fu. At Ching-yuan Fu he crossed the route followed in a north-south direction by Mr. Consul Bourne in 1886; but apart from this, the route as far as Ssŭ-chăng Fu was entirely new ground. Beyond the latter place little has been known of the route as far as Hsi-lung Chou, though it has been traversed by French missionaries. The last section, from Hsi-lung Chou to Yün-nan Fu, had been followed by a section of the French Commercial Mission above alluded to.

In the letters accompanying his survey sheets, Mr. Clementi says nothing as to the nature of the country traversed, or the general and commercial relations of its inhabitants—points upon which further information would be welcome. His original map gives, however, rough indications of the general character of the ground on either side of the route, and these have been reproduced in our map, so far as the scale permits.

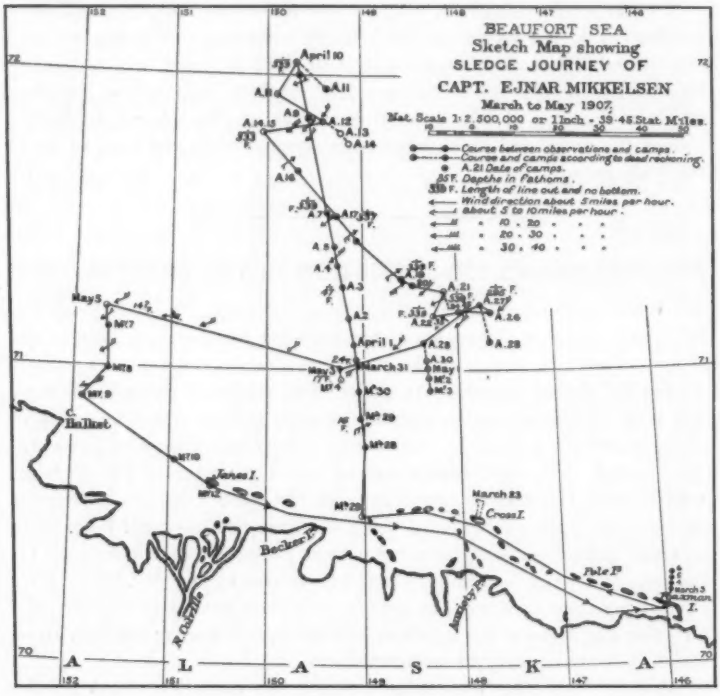
MR. MIKKELSEN'S ICE-EXPEDITION IN THE BEAUFORT SEA.

We have received from Mr. Mikkelsen, by mail, a full report on his this year's work in the region of the Beaufort sea, and especially of the sledge expedition over the ice, made by himself and two companions during the spring months. It shows that, while no sensational work has been attempted, some valuable results, from a scientific point of view, have been gained by the patient collection of facts and observations which will considerably extend our knowledge of the physical conditions of the area in question. At the same time, the experience gained during the execution of the preliminary task—itself beset with no small difficulties and dangers—should prove of great assistance for the more serious undertaking to be attempted next year. Mr. Mikkelsen's narrative enters into copious details as to the nature of the ice, the direction and force of the winds and currents, and similar matters, all of which it is unnecessary to reproduce here.

Besides describing the sledge journey, the narrative clears up the obscurities which had existed as regards the loss of the *Duchess of Bedford*. The vessel sprung a leak on January 27, apparently, Mr. Mikkelsen says, through the forcing out of the caulking when the ice contracted, for the ship was in a perfectly land-locked sea, with no motion of the ice. The pumps were kept going incessantly, but this merely availed to keep the ship afloat during the building of a house on the shore and the transport of the stores to it, at which work help was obtained from the Eskimo, who were numerous on Flaxman island at the time. On April 11 the crew moved ashore, the ship then rapidly filling with water, which froze in the hold. After the return from the

sledge journey, Mr. Mikkelsen decided to break up the hull in order to get more building material, there being no possibility of doing any repairs.

A first start for the sledge journey was made on March 3. The land-floe formed the previous autumn had been constantly broken up by westerly gales, and at this time consisted of fields of young ice, with some heavy pressure ridges. Open leads frequently stopped the party, and after a time the ice became so heavy that it proved necessary to



return, the sledges breaking down through being too heavily loaded for such rough ice. A second start, with somewhat lighter equipment, was made on March 17, Mr. Mikkelsen being accompanied by Messrs. Leffingwell and Storkersen. Food was taken to last for sixty-five days from the final start seawards, besides a week's supply to be cached for the return. Bad weather prevailed for a time, and, the ice to the north showing no improvement, it was found necessary to keep a westward course to about 142° W. before striking north, which was done on March 28. The conditions were now more favourable, large fields of

young and level ice being met with, apparently due to a recent retreat of the pack from the shore and the freezing over of the intervening space. Presently, however, the ice became worse, consisting of heavy

FIG. 1.—PALÆOCRYSTIC ICE-FLOE.

FIG. 2.—HEAVY RUBBLE ICE.

floes of the preceding year, with pressure ridges, and lanes covered with thin ice. Soft, deep snow also caused much trouble. The further the travellers advanced, the greater was the quantity of old floe-ice encountered, and this afforded fairly good going (Fig. 1). Mr. Mikkelsen

terms it "palæocrystic," though recognizing that it differs from that which has previously been known by this name. The floes have rounded hummocks, and are perfectly covered with snow of a yellowish tint. The ice is quite fresh, and when fractured show the same blue colour as is seen in glacier ice.

In order to make a road the pickaxes were kept in constant use, and without them progress would have been impossible. As it was, the sledges suffered severely, and Mr. Mikkelsen found that a mistake had been made in not fitting them with steel-shod runners, the German silver employed proving quite insufficient for the heavy work required of it. On April 3, at about 43 miles from land, rough ice of the character that had stopped the advance further east was encountered, but it fortunately did not extend very far (Fig. 2). A sounding here gave no bottom at 86 metres (47 fathoms), the depths previously obtained being 30 and 44 metres respectively (16 and 24 fathoms). The sounding machine had not yet been rigged up, and when this was done, a sounding on April 7 gave no bottom at 620 metres (339 fathoms). Subsequent soundings, up to 32 miles further north, gave no different result, and the chances that the unexpectedly great depths were due to the presence of a submarine valley were thereby much lessened. Mr. Mikkelsen therefore feels confident that the edge of the continental shelf (which, it may be noted, is considered to occur on an average at a depth of about 100 fathoms) had really been passed.

On April 9 a longitude was taken, which showed that, instead of being east of the starting-point, as had been supposed from the dead-reckoning, the party were 20 miles to the west of that point, this being due to drift, which had evidently set in a northerly direction as well. The larger bodies of old ice (Fig. 3) were often bordered, on the west, by stretches of thin ice, and in crossing one of these pressure commenced, lanes opening up while the explorers were in the middle of it. On April 10 a great number of cracks (Fig. 4), some very wide, were encountered, and the explorers resolved to turn back, travelling south-east until soundings should be reached, and then following the edge of the shelf as far east as possible. But in spite of all attempts to make easting, observation constantly proved that the drift had taken them to the west instead, sometimes even against the wind. They continued to take soundings, but even with 70 metres of spare line added to the 620-metre wire, no bottom could be reached, although 44 metres had been obtained in a latitude only 16 miles further south. At last, on April 22, a sounding of 63 metres (34 fathoms) was obtained, and a north-and-south line was run to determine the slope as exactly as possible. From 88 metres (48 fathoms) there was a drop to 220 metres (120 fathoms) in three-quarters of a mile, while the last sounding (with bottom) of 519 metres (284 fathoms) occurred only $2\frac{1}{4}$ miles from the starting-point. Landwards, progress was stopped

at the end of a mile by a wide crack, the depth being here 50 metres (27 fathoms). The lead was unfortunately lost in taking this last sounding, but for a time the small pickaxe was used, until this too was

FIG. 3.—PALÆOCRYSTIC ICE-FLOE.

FIG. 4.—CREVASSE IN PALÆOCRYSTIC ICE.

lost—a serious misfortune, as the larger one had previously been dropped through a thin sheet of ice. Next morning a strong set to the west-north-west was apparent (with a wind from east-south-east), and a

new sounding through the hole where 88 metres had been obtained, gave a depth of 171 metres. On April 26 the thermometer stood for the first time above freezing, and the going was bad. The raft was used for the first time to ferry the party across a lane 100 yards wide. It was made by lashing two sledges together with poles and covering the frame so formed with a piece of canvas, and it could carry a sledge loaded to a total weight of 320 lbs., with a man to pull it across. It was used without mishap, and as the extra weight carried for this purpose was only 22 lbs. (including 14 lbs. for the canvas, also used as a tent cover), the device certainly seems to have proved a success.

The frequent ridges, together with heavy rubble covered with deep, soft snow (Fig. 6), now made the going worse, but a more serious hindrance was caused by the numerous lanes covered by ice too thin to walk over. Relative motion of the ice was also perceptible. With a stronger drift to the west than could be overcome by walking east, there was nothing for it but to make for the land, which proved more difficult than had been expected. It was sometimes necessary to cross the cracks upon the small ice and slush which filled them, and disaster was often narrowly escaped. A dark-water sky showed itself all round, and on reaching the edge of the pack, a stretch of perfectly open water separated the travellers from the land-floe. While waiting for the crack to close up, the piece of ice on which they were camped broke off and floated over. Abundant animal life was seen in and about the crack, including a bear, ducks, seagulls, and seals—the last of which were seen whenever there was open water. Many tracks of foxes were seen, especially at about 50 to 70 miles from the land. Crossing the land-floe, the lagoon-ice was struck on May 9, and by following the mainland or the sandspits, the party reached camp on May 15. The trip, which lasted 60 days, had covered in all 533 nautical miles.

Besides the soundings already mentioned, the journey had determined the fact that at this time of year there is a strong drift to the west with an easterly wind, but little or none to the east with a westerly one. In summer, when the ice is more free to move, and when easterly winds prevail, the westerly drift would naturally be considerably greater. Yet the experience of explorers and whalers shows that plenty of ice is met with during the summer along a great part of the coast. The exceptional character of the old floe-ice encountered by Mr. Mikkelsen (which he thinks older than any seen by him on the east coast of Greenland) would seem to indicate that there is no unobstructed road to the westward, but that this ice is formed in a land-locked sea. The absence of drift to the east, even with a westerly wind, would seem to argue an obstruction to the eastward, yet if the continental shelf is as narrow as seems to be indicated, there would be little room for it in this direction. Mr. Mikkelsen thinks that the land reported as lying north of Point Barrow and Harrison

bay is probably old heavy ice, which, seen in a certain light, conveys the idea of distant land, the Eskimo accounts of rounded hills on the supposed land strengthening this idea.

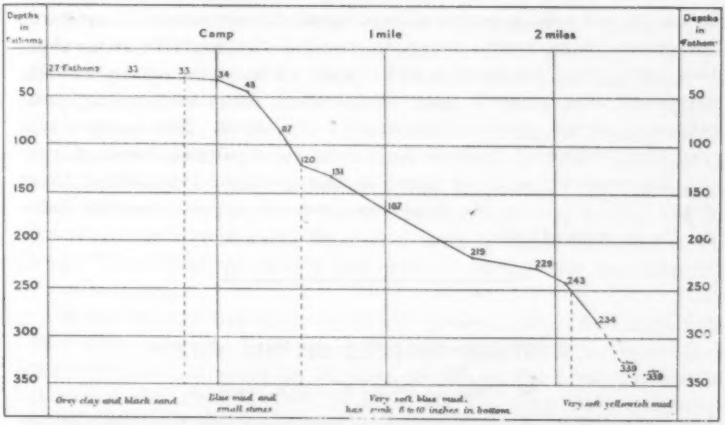


FIG. 5.—SOUNDINGS TAKEN OVER THE EDGE OF THE CONTINENTAL SHELF, APRIL 22, 1907. STATION AT CAMP, LAT. 71° 12′ N., LONG. 148° 24′ W.

FIG. 6.—HEAVY RUBBLE AND DEEP, SOFT SNOW.

The result of the year's work include hourly tidal observations at the camp from the early autumn to January 1, and for three days at Icy reef and Pole island. Meteorological observations have been kept up without interruption, while Mr. Leffinwell has determined several

positions astronomically, and has corrected the map of the coast from Flaxman island to Herschel island, besides undertaking surveys and geological work inland. Mr. Stefansson, after failing to find the ship at Herschel island, travelled about with the Eskimo, learning their language, and taking many anthropological measurements. As regards the future plans, it was hoped to continue the scientific work along the coast during the autumn and winter, while for the spring a sledge expedition was planned from Demarcation point northwards, until soundings should give no bottom at 1200 metres. The party would then work southward towards the edge of the continental shelf, following this westward as far as possible, possibly to the longitude of Cross island (147° 50′ W.). Mr. Mikkelsen does not expect to return home till the autumn of 1909.

WESTERN SOURCES OF THE NILE.

By Lieut. D. COMYN, Black Watch.

THE hydrography of the Nile and its tributaries has, from the earliest times, been of interest. Hence I venture, as one with the authority of a Didymus, to attempt to throw some light on what I see is even now in intense obscurity. Such, however, is the variety in the nomenclature of a single river, that the reader must be prepared for it. To one uninitiated it would appear as though he were running the description of several countries into one another, such a wealth of rivers being impossible in one. For instance, one of the two main streams of which I am about to write has three distinct names. It has others, but the people, through whose country it flows, are generally agreed on calling it the "Boru" from its source to somewhere near Jebel Talgona; "Telgona" to the Dinka country; and the "Lol" from there to its junction with the Kir river. Once a guide was able to tell me of fourteen names for one mountain. And it has frequently happened that, when travelling on a road I had previously mapped, I found the names of the various features given to me by the second guide entirely different from those given me by the first—the reason being that each tribe (and they are numerous), I might almost say each village, has its own name for them. As, however, this is generally the case in all really savage countries, I need not enlarge on the subject.

The mouth of the Bahr el Arab, the river itself for the short way near it, and likewise part of its tributary the Lol, have been explored by Captain Percival, D.S.O., and Lieut. Bayldon, R.N. Their explorations, combined with information drawn from the maps of the old explorers, have, however, led authorities into the mistake, I should add the very natural mistake, of thinking that three waterways of importance are

to be found flowing east from the hills of our western frontier, whereas there are but two. The above-named officers determined positions, as I have already said, at and near the mouth of the rivers in question, and I nearer their sources.

Khor Dabura is the only watercourse with any pretence to importance between the Telgona river and the Bahr el Arab (known at this the eastern point I crossed it (Sheikh Shenoa's village) as the Bahr el Rizeigat), beyond which is five days' "atash" (drought) to Abu Gabra, the wells of Shaka, in Darfur. It is a small watercourse flowing south-east to the Boru river. Its only claim to notice is that it contains an abundant supply of water some 8 feet from the surface in the dry season. This, in a country where water is comparatively very scarce, was no doubt the reason that made Dr. Felkin mark it with a thick line on his map. This being the case, it goes without saying that the third big river is a myth.

Since the regretted death of Colonel Sparkes, C.M.G., I find myself the only white man who has crossed the headwaters of all the rivers from the river Wau, in about lat. 6°, long. 26° 30′, to the river Umbelacha, otherwise the Bahr el Arab, in about lat. 10°, long. 24°; and lower down again on each, more than 100 miles, as the crow flies, from the first point of crossing.

In the first place it is of interest to tabulate the rivers and their important tributaries with which I have to deal—

	Tributaries.
River Jur, or Sueh	River Wau or Buseiri
River Boru (other names Telgona and Lol) — ...	Pongo or Ji Kuru or Chell (Tyell) Sopo Raga Dabura
River Umbelacha (other names, Bahr el Arab, specifying some tribe on its banks, *e.g.* Bahr-el-Rizeigat, -el Homr, and Kir)	Barada or Obo Vongo Reikei Yofo Serri (sandy) Sheileika (sandy) Kavaduka Janverindi (sandy) Gotelo

The tributaries of the Boro (Telgona or Lol) appear to me worthy of description. The main river seems to be the chief waterway of the west. Not only do they contain water all the year round, and further are themselves, for the most part, not low-banked channels of sand, as those of the Bahr el Arab, but noble rivers, for a good portion of the year undoubtedly navigable by shallow-draught steamers of a small type already known in the Sudan. There being no sudd in them, the question of screw or stern wheel need not be considered. (The sudd-cutting party at the mouth of the river Kir has not yet finished cutting a channel there (1906).)

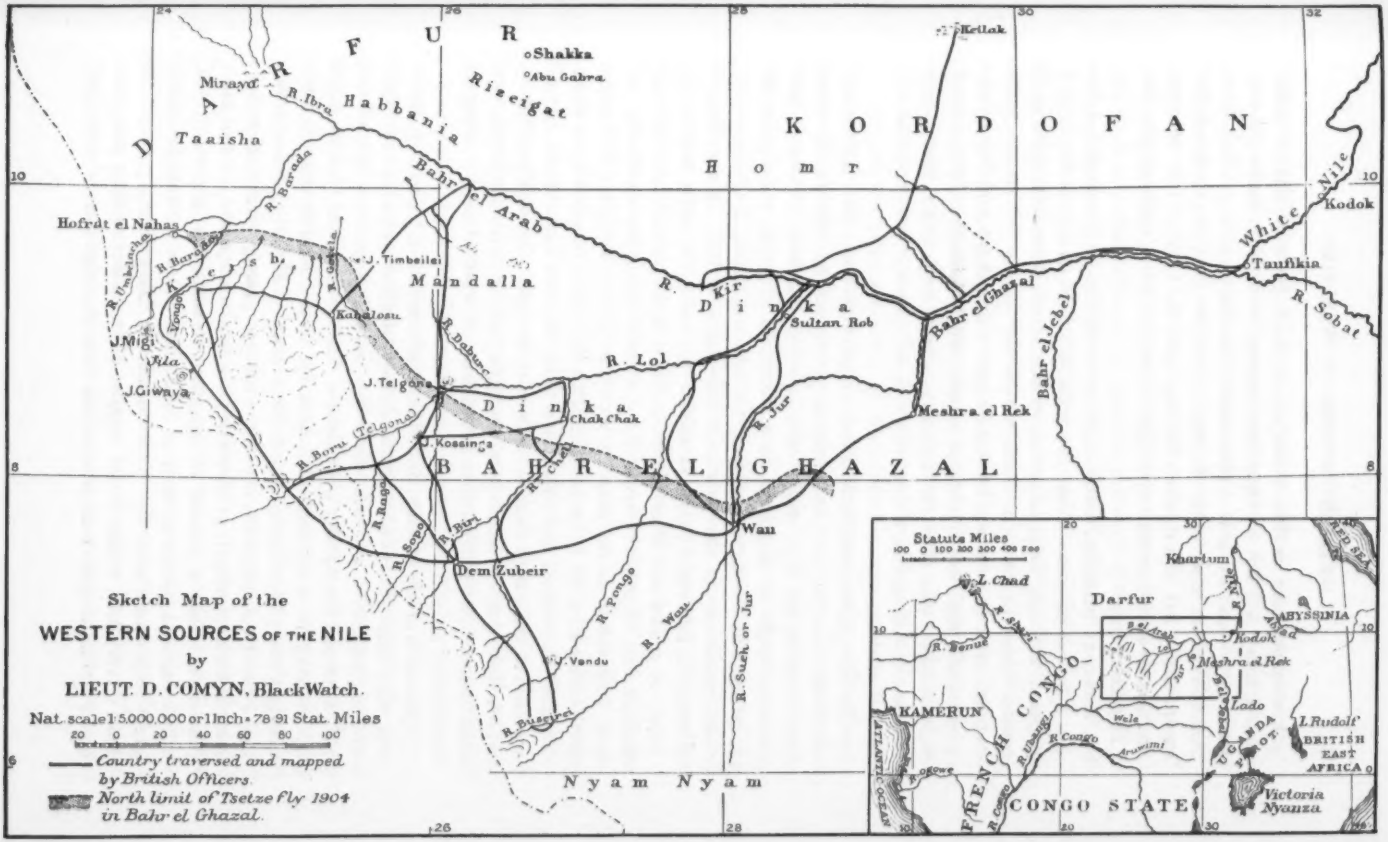
The country in which these rivers take their sources is more undulating than hilly. Unlike the country round the source of the Bahr el Arab, a hill is here a remarkable feature.

A hundred miles south of the well-known station Dem Zubeir is the Buseiri. It is one of the five tributaries which, when joined together, form what is known as the river Wau. I crossed this river at two points a few miles apart, and of course saw its junction with the river Jur near the military station Wau, the Fort Desaix of the French cartographers. At the western point I found the river about 20 yards across, banks about 20 feet high, flowing in a sandy bed through what, in the rainy season, would be a swamp about half a mile across on both sides. This swamp may be due to the junction of several big khors at this place. The western khor was a broad and shallow depression, the others almost rivers—small ones—which at that time, the height of the dry season, still boasted a trickle of water. Further north I had found sources of these khors to be water-holes connected by swamp with a steady flow of water between them. Following their course I occasionally noticed all signs of flow and swamp disappear; then I crossed a rise of ground, and the continuation of, as far as I could judge, the same streams cropped up again. The character of the Buseiri changed very soon. Big trees lining the banks, it ran between small steep hills, the foot of which formed them. There it was still as wide and with banks as high as before, though the bottom was rather rocky.

I crossed the Pongo, there known as the Ji, at a point some 10 miles south of Jebel Yandu. I marched down a marshy depression in the centre of which was a "gallery wood," and came upon the river, there a babbling brook with a stony bed about 12 feet wide, banks about 6 feet high. Trees interlaced themselves over the water. On my return march, 20 miles more to the east, I found the river at the bottom of a well-marked valley. There it was as broad and of the same character as the river Buseiri. On the road from Wau to Dem Zubeir one crosses the same river. It is there a fine stream over 40 yards across, with a sandy bed, the country on both banks being rather flat. Captain Percival, D.S.O., followed up this river from the Wau-Dem Zubeir road to its junction with the river Lol.

The next important stream is the Kuru, which, from the junction of its fine tributary the Biri, is known to the Dinkas, through whose country it passes, as the Chell. I crossed the Kuru, which I have followed to its junction with the Telgona or Lol, about 60 miles south of Dem Zubeir (about long. 26° and lat. 7°), and even there it was a fine stream receiving many large khors to swell its volume. Up to its junction with the Biri it flows on a rocky bed through high undulating country.

At one point I stood on a very steep hill immediately above the river, which meandered through thick forest quite 200 feet below me, a


DARFUR
KORDOFAN
BAHR EL GHAZAL
Shakka
Abu Gabra
Mirayd
R. Ibra
Habbania
Rizeigat
Taaisha
Homr
Kellak
Kodok
Hofrat el Nahas
R. Borgeda
Bahr el Arab
R. Kir
Dinka
Sultan Rob
White Nile
Taufikia
R. Sobat
Bahr el Jebel
Bahr el Ghazal
Meshra el Rek
Mandalla
J. Timbeila
Kandelosu
R. Dabweg
R. Lol
J. Migi
J. Giwaya
J. Telgona
Dinka
Chak Chak
J. Kossinga
R. Borru (Telgona)
R. Jur
R. Rago
R. Sopo
R. Buri
R. Chel
Wau
Dem Zubeir
R. Pongo
R. Wau
R. Such or Jur
J. Vandu
R. Biggeri
Nyam Nyam
Sketch Map of the
WESTERN SOURCES OF THE NILE
by
LIEUT. D. COMYN, Black Watch.
Nat. scale 1:5,000,000 or 1 inch = 78·91 Stat. Miles
20 0 20 40 60 80 100
Country traversed and mapped by British Officers.
North limit of Tsetze fly 1904 in Bahr el Ghazal.
Statute Miles
100 0 100 200 300 400 500
L. Chad
Darfur
Khartum
ABYSSINIA
R. Benue
R. Shari
Bahr el Arab
Kodok
Meshra el Rek
KAMERUN
FRENCH CONGO
Lado
Wela
R. Congo
Aruwimi
UGANDA PROT.
L. Rudolf
BRITISH EAST AFRICA
R. Ogowe
CONGO STATE
Victoria Nyanza
RED SEA

unique experience in this country. After its junction with the Biri, also a rocky but not so important stream, it widens out to about 70 yards with a sandy bed. The country on both sides is much flatter than anywhere else west of long. 27°. In fact, it is strange how exceptionally flat it is between the Sopo and the Chell. The watershed of these rivers is almost imperceptible for 100 miles south of the Boru (Telgona river).

The next tributary that claims our attention is the Sopo. I have also followed its course from the point where it is a tiny brook to its junction with the Telgona or Lol, which latter, from this place to its source, takes the name of Boru, which, the natives inform me, means "stony," and it does not belie its name. The Sopo and the Raga, a parallel and still less important stream which joins the Boru some 60 miles further west than the former, are both very rocky, taking their rise near the Mongaiat, a most extraordinary mass of round smooth bare hills of solid stone.

We have now reached the Boru, Telgona or Lol. But few miles of its course have not been traversed as yet by British officers. I crossed this river at the foot of the hills in which it rises. There it flows between banks 20 feet high, in a rocky bed 20 yards wide, quite 300 miles west, as the crow flies, from the scene of Lieut. Bayldon's (R.N.) sudd operations at the mouth of the Bahr el Arab on the Bahr el Ghazal. I followed it on and off for the next 150 miles east of this point, to where the river Kuru or Chell flows into it, and 50 miles further east Captain Percival, D.S.O., crossed it, there called the Lol, and followed it to its junction with the Kir. The last 200 miles, as the crow flies, up to its junction with that river, it ceases to be rocky. No khor or river of any importance joins the left bank of the Lol till we come to the Kir, or Bahr el Arab, with the exception of Khor Dabura, which flows into it somewhere near its junction with the Chell; and still further west several deep khors, none of which, however, deserves mention.

The hills of the frontier, and right high ones for this country, throw out what might be called a peninsula (starting between about lat. 8° 30′ to 9° to long. 25°), and thus form the watershed between the affluent rich Boru and the equally poor Bahr el Arab. The Bahr el Arab starts life flowing in a northern direction for over 50 miles through hills, taking a sharp turn to the east in the vicinity of Hofrat el Nahas, where it is a fine river, 100 yards broad, the bed being sandy, with huge smooth reefs of rock crossing it at intervals; the banks are about 15 feet high. This means that a number of mountain torrents flow westward to it, which explains its size so early in its course. These torrents are not of great importance save the river Barada (or Obo), wrongly called the Bahr (river) Ada, which is the smaller of the sister streams that meet about 100 miles from their source, and form the mightier and celebrated

river. It might be added that, from native information, it appears that near this point of junction the river commences to flow through "butas," *i.e.* swamps that are quite dry and covered with fine grazing for the better part of the year, and with water some feet deep during the river flood.

Of those that flow northward to join it after it has taken its turn, the most important, crossed by me from the east, is the river Gotelo, a perennial stream, in which was a flow of water when I crossed near Kabalosu—not far from Jebel Timbeilei (marked on Felkin's map). The bed of this stream is peculiar, the only one of its kind I have seen in this country—viz. very sharp knife-like edges jutting out from both sides of the river-banks. I was told that this stream always, even in the worst years, contains flowing water; I understand the only one that does in these parts. Certainly when I crossed it—it was a dry time, very dry—there was a very perceptible flow of water from pool to pool.

Others are most peculiar; *e.g.* the river Sheleika consists of a dry channel of deep sand 80 yards broad with very low banks. There were some pools of water in most, but some were quite dry. Then, further west, we come to the Reikei and the Vongo, both fine rivers, though small—the former rising where the road passes Jebel Giyawa (or Jila, the name of the district at its foot), and being a fine stream on the Kabalosu road, about 50 miles further north-east; the latter, running parallel to the river Barada, rises near Jebel Migi, and, but for the amount of water it holds, would be little more than a khor.

Standing on the summit of Jebel Migi, about long. 24°, lat. 9°, I was shown the hill, about 100 miles away, near which the Bahr el Arab rises—its "Ras el moya." As the "Umbelacha" to the Kreish (a tribe of those parts), it runs till it is joined by the Ibra, the outlet of the "Miraya," a sort of swamp which, I am told, takes in the flow of a number of wadis, which form the water system of Darfur to El Fasher and beyond. This is, however, hearsay. From that point the sandy bed disappears (this I have heard from the Kreish and Arabs), and the river, taking the names of the various Arab tribes who graze their flocks on its "butas" when sufficiently dry, becomes what I found it to be about 150 miles in a straight line from Hofra en Nahas. A long and waterless march had brought me to this point, Sheikh Shenoa's "village." There I found the river to consist of a mud channel 20 yards broad and 20 feet deep, with trees dotted along its banks, flowing in the centre of a vast plain some miles across. This, I was told—indeed the evidence of my senses would have done that had I been alone—is overflowed to the depth of 4 feet or so when the river is in the full flood, which rises and falls very rapidly.

I had not been many minutes there before I was surrounded by a number of Rizeigat sheikhs and Arab merchants. They all told me, as did men of my escort who knew the country, that the river was known

at various points by the name of the tribe which grazed its flocks on its banks—all Arabs—till finally it entered the Dinka country, and changed its name from Bahr el Homr to Kir. Also that there was, north of where we were, an almost waterless stretch of country to Abu Gabra (the wells of Shaka). (When I myself was at the junction of the Chell and Lol, the Dinkas told me that a short distance to the north was the big Arab river.) A hundred and fifty miles or so further east, Captain Percival, D.S.O., crossed it, and followed it to where the Kir and Lol become one.

It has been suggested that the river that flows by Hofra en Nahas is not the Kir; but unless the latter is the Khor Dabura, which is denied by the natives, and which is so insignificant 100 miles from the junction of the Kir and Lol to render it, flowing as it does in a flat country, a miracle of growth, were it to become what the Kir is reported to be, which would be physical impossibility, the tenet cannot be maintained, so I fail to see where a third river can be fitted in. Nor is the Kir and Gotelo one. The remarks applied to the Dabura apply equally to the Gotelo.

From the river Wau to the Bahr el Arab, every stream except the Pongo, from the immediate vicinity of its source to its junction with a greater river, has been followed by myself. I except unimportant tributaries of the Bahr el Arab, whose courses ran within the triangle of my marches. Along the watershed I have crossed the headwaters of all streams from the Wau to the Bahr el Arab (Umbelacha). And again, from the Bahr el Rizeigat to the Boru, I have found no stream to cross: all those, on another line I had traversed, flowing west. Hence I do not think that there can be any doubt remaining as to the water system of the western sources of the Nile.

The inviolability of frontiers has prevented me going to Shaka, neither would my duties have brought me there at the time, but the road to that place is as well known and almost as well beaten as the Grand Trunk road of India.

A glimpse at the attached map, showing the actual routes traversed by British officers (in so far as they affect this subject), and the flow of any streams, will, I fancy, render my attempted exposition clearer.

It must be remembered that, when talking of a "fine" river, the term might be misunderstood. I mean thereby a stream in which, in the dry season, one finds a large pool of water every few hundred yards, and which, in the wet season, brings down a large, deep flow of water.

THE RÔLE OF ALGAL GROWTH IN THE COLONIZATION OF NEW GROUND AND IN THE DETERMINATION OF SCENERY.

By F. E. FRITSCH, D.Sc., Ph.D., F.L.S., Assistant Professor of Botany, University of London, University College.

The study of plant-ecology, *i.e.* of the relation between plant and habitat, between a piece of vegetation and the prevalent conditions in the area in which it is developed, is making rapid strides at the present day, and, as our knowledge in this respect increases, we are beginning to inquire more carefully into the methods of colonization of new ground by plants. The study is an important one, not only in its scientific aspects, but also from the economic and geographical point of view, and a brief consideration of some of the early stages in colonization may not be without interest.

In many cases new ground may from the very first be in a suitable condition for the growth of higher plants (Vascular Cryptogams and Phanerogams), as, for instance, in the case of a dried river-bed,* or the alluvial deposit laid down in the lower stretches of a large river. Here the ground afforded for colonization is both finely divided and impregnated with a certain amount of organic substance (humus), so that a soil is present at the outset. In other cases, however, the ground is not ready for immediate colonization, either requiring disintegration for the production of soil or formation of a certain amount of humus to render the soil fertile, and to enable it to retain a sufficient amount of water. Disintegration is, of course, always a primary necessity before any higher vegetation can make its appearance on a bare rock-surface, whilst frequently the formation of a certain quantity of humus is obligatory for the development of anything more than a very meagre growth of plants.

Not at all uncommonly various terrestrial or semi-aquatic Algæ play a very important part in preparing the way for higher forms of plants, serving either both as disintegrators and humus-producers, or merely in the latter capacity. Their agency is by far the most evident in the tropics, although Algæ are commonly found to be active in much the same way (though not to so marked an extent) in our parts of the world. The observations I have to record are very incomplete, and I have no doubt that many more facts than I can produce will become evident in course of time. Since the essential phenomena are so much more obvious and more readily studied in the damp parts of the tropics, I may be excused if I commence my description by detailing certain observations made in Ceylon in the course of a study of its subaërial algal vegetation.†

It is, moreover, in the tropics that these subaërial Algæ often place a very decided stamp on the scenery of a district, a point which is well illustrated by Welwitsch's ‡ description of 'The Pedras Negras of Pungo Andongo in Angola.' These black

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* M. C. Stopes, "The Colonization of a Dried River-bed," *New Phytologist*, vol. 2, 1903, pp. 186–192; cf. also Scott Elliot, "The Geographical Functions of Certain Water-plants in Chili," *Geo. Jour.*, vol. 27, 1906, pp. 451 *et seq.*; V. P. Jaeger, "Jetzt und Einst. Eine pflanzengeographische Skizze," 52 Jahresber. d. fürsterzbischöfl. Gymnasiums am Coll. Borromalum z. Salzburg, 1900-01 (Salzburg, 1901), pp. 1–48.

† Cf. also Fritsch, "A General Consideration of the Subaërial and Freshwater Algal Flora of Ceylon," Part i., *Proc. Roy. Soc. London*, Series B, vol. 79, 1907, p. 197 *et seq.* (Sect. *a* of this paper deals with the subaërial algal flora.)

‡ Welwitsch, in *Journ. of Travel and Nat. Hist.*, vol. 1, 1868; also 'Apontamentos Phyto-Geographicos solve a flora da provincia de Angola, etc.,' Annaes do Conselho Ultramarino, Parte não off. Ser. 1, Dez. 1858, p. 533.

rocks owe their colour to the abundant growth of a subaërial Alga (*Scytonema Myochrous* (Dillw.), Ag. var. *chorographicum*, W. and G. S. West), which "during the rainy season generates and multiplies so rapidly that the upper portions of the mountains are covered with it in a very short time. . . . Soon after the hot season has set in, at the end of May, when the horizon above the Presidium is generally clear and bright, the black plantlets begin to discolour with the intense heat. They gradually become dry and brittle, until they peel off altogether by-and-by, after which the rocks lose their sombre black aspect, and reappear in their natural grey or grey-brownish colour before the succeeding spring." I am not aware of any other definite record testifying to the abundance of subaërial algal growth in the tropics.* In the case of the subtropical Azores, however, Bohlin † describes the occurrence of four terrestrial Algæ (*Chroolepus aureus, Zygogonium ericetorum, Glœocapsa Magma, Stigonema minutum*), "vivant sur le sol nu . . . en très grand nombre."

I did not see anything quite as striking as the growth, described by Welwitsch, in Ceylon, but similar phenomena on a less extensive scale are abundant enough. If the damp regions of Ceylon were robbed of their subaërial Algæ, an important characteristic of local scenery would be lost. Every wall, rock, tree-trunk, etc., bears a more or less dense sombre covering of algal growth, and the drier localities in the island (*e.g.* Hambantota, Anuradhapoora) show us how different our surroundings look when the conditions (viz. insufficient moisture) do not admit of the development of such algal vegetation. On the other hand, wherever the rainfall becomes excessive (as at Labugama, with 166 inches), the subaërial Algæ form a thick covering on every conceivable object. The marked difference cannot fail to strike any one who is at all observant of his environment.

In our parts of the world we are accustomed to see exposed objects covered with a bright green powdery or filmy covering, which is due to green Algæ like *Pleurococcus* and *Hormidium*. In many cases this covering presents a yellowish-green colour, owing to an intermingling of fungal hyphæ with the Alga (an initial stage in Lichen-formation, cf. p. 543). We are so used to the presence of such a coating that the general influence it has in brightening up the scene is scarcely noticed, until we visit a neighbourhood in which for some reason or other it is not developed. But the algal growth found on similar substrata in the tropics is much more extensively developed, and consequently much more obvious, whilst a little careful study teaches us that it fulfils a much more important duty than it generally does in temperate regions, viz. that of preparing the ground for vegetation of a higher type.

The agency of algal growth in this respect has already been emphasized by Treub ‡ in describing the recolonization of Krakatoa after the eruption of 1886. He describes how members of the Cyanophyceæ (*Tolypothrix, Anabæna, Symploca*, and *Lyngbya*) are the first forms to put in an appearance. In his words: "Il s'est trouvé que les cendres et la pierre ponce composant le sol de Krakatau, sont presque partout couvertes d'une mince couche de Cyanophycées. . . . De beaucoup la plus fréquent est le *Lyngbya Verbeekiana*; ensuite vient le *Lyngbya minutissima*. . . . Grâce à ces six espèces d'algues et à leurs gaines vides . . . le sol aride de Krakatau est recouvert d'une mince couche gélatineuse et hygroscopique. . . . Les algues

* See, however, Warburg, 'Ökologische Pflanzengeographie,' German edition (Berlin, 1896), p. 215; cf. also Fritsch, "The Subaërial and Freshwater Algal Flora of the Tropics," *Annals of Botany*, vol. 21, No. 82, April, 1907, p. 237 *et seq.* (in which all the data regarding extent and composition of tropical subaërial growth are considered).

† Bohlin, "Etude sur la Flore Algologique d'eau douce des Açores," *Bih. K. Sv. Vet.-Ak. Handl.*, vol. 27, Afd. III. No. 1, pp. 12, 13, 50, 51.

‡ Treub, "Notice sur la Nouvelle Flore de Krakatau," *Ann. Jard. bot. Buitenzorg*, vol. 7, 1888, p. 213; see also Penzig, *loc. cit.*, vol. 18, 1902, pp. 92 *et seq.*

préparent le terrain aux Fougères, en quelque sorte comme celles-ci le feront à leur tour aux Phanérogames." Observations of an analogous kind were made in Ceylon, and are dealt with below.

Apart from its exceptional luxuriance, which is especially noticeable in hot regions with a high rainfall, the subaërial algal growth of Ceylon, and probably that of the tropics generally,* differs from that of our parts in its composition. It is not, as a rule, bright green, but is dark in colour; it is by no means always developed as a powdery or filmy covering, but more commonly as a relatively thick tangled or tufted mass, forming a carpet-like coating on the substratum. The difference in colour is due to the fact that green Algæ are as good as wanting in the subaërial vegetation, which is composed almost entirely of a large number of different representatives of the so-called blue-green Algæ (Cyanophyceæ, Myxophyceæ). This group, which includes unicellular, colonial, and filamentous forms, is not quite unimportant even in our parts, some of the bright blue-green, and especially the dark blue-green coatings, frequently seen on rocks, pavements, etc., being due to members of this group. But the large majority of the Cyanophyceæ require a high temperature for successful growth, being, for instance, amongst the only plants which are found in the warmer waters of hot springs (Carlsbad, Yellowstone Park, Iceland, etc.). Nor is it difficult elsewhere to convince one's self that a high temperature is a primary necessity for the rich development of these algal forms; any damp hothouse furnishes abundant proof (*e.g.* the *Nepenthes*-house† in the Royal Botanic Gardens at Kew, in which a number of the photographs illustrating this paper were taken). The Cyanophyceæ show many peculiar characters (*e.g.* the curious cytology, the heterocysts, the hormogonia, etc.), which seem to be archaic, and there seems also good reason to believe that numerous forms of this or similar groups existed in past ages of the world's history, though of necessity the fossil records are rather meagre. This being so, we need not wonder at the excessive development of this group in the moist tropics, for there we have conditions which probably come nearest to those obtaining in the earlier epochs. Certain members of the group have, indeed, learnt to suit themselves to the lower temperature and smaller humidity of temperate regions, but the evident paucity of most of them, both in number of individuals and in extent of development, points to the prevalent conditions not being the most suitable. In the tropics, however, we see this group in its natural habitat, and it seems very probable that many dubious points about it will be settled by studies carried on in those regions.

High temperature and a damp atmosphere are no doubt essential for the development of the luxurious algal covering seen in many parts of the lowlands of Ceylon; but these two factors are not the only ones to account for the abundant growth of blue-green Algæ, and the practical lack of subaërial green forms. The absence of the latter is due to the operation of a third factor—the light. It is a familiar fact that the chlorophyll of plants gets decomposed by light above a certain degree of intensity, and there can be no doubt that in an exposed situation in the tropics the light is too intense for simple green forms without adequate arrangements for the protection of their chlorophyll. Indeed, even Mosses and Liverworts, which form a luxuriant vegetation on the tree-trunks in the shady jungles, etc., are very scarce in all exposed situations. The blue-green Algæ, however, are better equipped. In their

* See Fritsch, in *Annals of Botany*, April, 1907, p. 238 *et seq.* The observations of Welwitsch, Bohlin, and Treub quoted in the preceding paragraphs point to the great importance of blue-green forms in every case.

† Cf. Fritsch, Algæ, in "The Wild Fauna and Flora of the Royal Botanic Gardens, Kew," 'Bull. Misc. Inform. Roy. Bot. Gards., Kew,' Addit. Series V., 1906, pp. 187 *et seq.*

cells the chlorophyll is accompanied by a blue or otherwise coloured pigment (phycocyanin), the two being so closely intermingled that even high powers of the microscope do not admit of their distinction. The resulting colour is in all shades from bright blue to blue-green or almost black; brown is also no uncommon tint. The additional colouring-matter certainly acts as a screen to the chlorophyll in these Cyanophyceæ, and thus enables them to exist in the intense light of exposed tropical habitats, which is fatal to the existence of the lower green forms. It seems very probable that the diverse shades of pigmentation observed in the blue-green group may be connected with the diverse types of illumination in different habitats. The cells of the Cyanophyceæ are, moreover, generally provided with thick mucilaginous sheaths, which are often highly coloured, and then no doubt serve as a further screen to the chlorophyll. Before leaving the discussion of the part played by the light in determining the essential character of tropical subaërial algal growth, we may notice that there is only one genus of the green Algæ that occurs abundantly in the latter. This is a filamentous form—*Trentepohlia* (*Chroolepus*), species of which are not uncommon in temperate regions, especially in mountainous districts (where there is strong insolation). They are very common in Ceylon, however, and form bright orange-red tufts arising amidst the dark Cyanophyceous growth and constituting a frequently agreeable interruption to its monotony. There is abundant evidence to show that species of *Trentepohlia* also play a great part in other tropical regions.* The orange-red colour is no doubt the secret of the success of this form; † the cell-sap contains a yellowish-red oil (hæmatochrome), which forms a mask to the chlorophyll, and, like the phycocyanin in the blue-green cell, protects it from the harmful action of the light. The colour of one and the same species of *Trentepohlia* varies according to the habitat; in exposed positions it is deep orange-red, in protected localities almost pure green. The masking colouring-matter thus appears to be developed under the influence of intense light only. The species of *Trentepohlia* are a particularly striking feature on the trunks of the coconut trees in the plantations near the seashore and on roadside embankments. They are also very common in the uplands of Ceylon.

There is yet another factor operating in the tropics which may lead to the suppression of the growth of the simpler green forms, whilst the blue-green element appears well equipped to withstand it. I refer to the occasional occurrence of periods of desiccation, which, in all probability, come on much more rapidly, and are much more intense in their effect, than they are in our parts. The existence of gelatinous sheaths round the cells of the Cyanophyceæ already referred to above is, no doubt, of immense importance from this point of view, experiment having shown that such forms are able to withstand very prolonged desiccation without coming to harm. In many of the blue-green Algæ these sheaths are tough and hard (e.g. *Lyngbya*, *Tolypothrix*, *Scytonema*, etc.), whilst in others they are highly mucilaginous and slimy (e.g. *Nostoc*, *Aphanocapsa*, *Glœocapsa*, etc.). The former seem more suited for extremes such as obtain in the lowlands of Ceylon than the latter, and it is interesting to note, in this connection, that the slimy forms are very much more abundant in the uplands (*e.g.* at Nuwara Eliya and Hakgalla at a height of 6000 feet and more). There they produce a scenic effect which is in striking contrast to the lowlands. The tree-trunks are frequently covered for several inches

* In certain parts of the tropics, however, species of *Trentepohlia* seem to be wanting (*e.g.* in the Sandwich islands; see Lemmermann, in Engler's *Bot. Jahrb.*, vol. **34**, 1905, p. 609).

† It may be noted that *Zygnema ericetorum*, which is another green Alga, playing a somewhat similar part in the subaërial vegetation (cf. Bohlin, *loc. cit.*, pp. 50, 51), also has a protective pigment in its cells in the form of the violet phycoporphyrin.

with these mucilaginous masses, which at first recall the resinous exudations often to be seen on wounded trees. At other points similar jelly-like diffluent masses project from amidst the dense growth of Mosses covering the tree-trunks. The relative humidity of the air is much greater in these uplands, and that probably accounts for the very marked difference in the character of the subaërial algal growth. In fact, a mere superficial observation of the algal flora could not long leave one in doubt as to the altitude of any locality in Ceylon. Compare, for instance, the embankment alongside of Lady Horton's walk at Nuwara Eliya with a similar embankment or wall at Colombo or Kalutara. At the time of my visit the former was covered with a thin gelatinous sheet composed mainly of a species of *Schizothrix* (with highly coloured orange-red diffluent sheaths enclosing narrow filaments; apparently *S. Lamyi*, Gomont) with various unicellular blue-green forms (Chroococcaceæ) intermingled, the colouring varying very much at different points, but being prevalently reddish. In the damp lowlands, on the other hand, a similar substratum would either bear a thin filmy growth of bright blue-green *Oscillaria* or of some Chroococcaceous species, or be covered by a sombre tangled or tufted coating.

I must not omit to mention that in the damp tropics subaërial algal growth is not confined to the tree-trunks, etc., but that some of these forms even manage to settle down on the foliage of the luxuriant higher vegetation. One not uncommonly finds various blue-green forms (and species of *Trentepohlia*) as epiphytes on the leaves, although this only obtains in very moist regions. The *Nepenthes*-house at Kew again furnishes good examples, and the photographs on Plate II. (A and B) are taken of leaves from this house. In addition to these more casual epiphytes, a number of genera of the Green Algæ (e.g. *Mycoidea*, *Cephaleuros*) have become highly specialized to life as leaf-epiphytes. They are disc-like forms firmly adherent to the surface of the leaf, and, like *Trentepohlia*, have their chlorophyll protected by the presence of a reddish-brown pigment in the cell-sap.

The preceding facts regarding the scenic effect of Cyanophyceous growth in the tropics become apparent without much detailed study, but a little careful investigation carries one much further. In the first place we should find that the blue-green subaërial element varies considerably in its mode of growth, so that it becomes possible to discriminate between four distinct types; and these types are noticed to succeed one another in a more or less regular manner in the colonization of new ground. The four methods of growth may be distinguished according to their general aspect as adhesive, tangled, tufted, and stratified. The adhesive type (Plate I., A and B) is the simplest and commonest, and is constituted by those forms, which grow as an encrusting film or as a gelatinous mass more or less firmly adherent to the substratum. The most abundant forms showing this type of growth are species of the gelatinous genera *Aphanocapsa*, *Glœocapsa*, *Nostoc*, and of the two filamentous forms *Oscillaria* and *Lyngbya* (especially the section *Phormidium*); typical adhesive films are generally due to the two genera last named. As a rule such films do not attain any considerable thickness. They are probably too compact to allow of the inward diffusion of the necessary amount of air for respiratory purposes, and consequently, where they attain any noticeable development (as in *Phormidium*), the inner portions of the lamellæ are composed of dead filaments. Although this explanation is hypothetical, it affords a satisfactory basis for an understanding of the adhesive and tangled types.

In the tangled type of growth (exhibited by species of *Tolypothrix*, *Hapalosiphon*, *Scytonema*, etc.), which is widely distributed in the moist lowlands of Ceylon, and is not uncommon though rarer in the uplands, we have the algal filaments entangled and interwoven with one another, so as to form wefts of varying degrees of compactness

A

B

PHOTOGRAPHS OF ADHESIVE GROWTH OF SUBAËRIAL ALGÆ ON WALLS OF HOT-HOUSES AT KEW.

C

D

TANGLED AND TUFTED GROWTH OF SUBAËRIAL ALGÆ ON WALLS OF *NEPENTHES*-HOUSE AT KEW. THE LEFT-HAND PHOTOGRAPH SHOWS COLONIZATION OF THE ALGAL SURFACE BY YOUNG FERNS.

PLATE I.

(Plate I., C; Plate II., C; Fig. 1, the lower part). This arrangement, of course, allows of the retention of a considerable amount of air between the filaments, and hence from the above point of view (viz. respiration) is much more advantageous than an adhesive growth. The air between the filaments would probably get dislodged by every fall of rain, and, as a consequence, it is often in no way manifest. But certain forms seem to take special precautions to prevent the frequent dislodgement of the air by growing in well-protected situations. Such forms, owing to the associated air, which, besides occupying the interspaces of the tangle, also covers its whole surface, are bluish-grey or bluish in colour, and often have a silvery appearance. They constitute quite a characteristic feature of the scenery in some parts of Ceylon. Thus, on the clay embankments round Peradeniya, I commonly found a brick-coloured or brownish-red tufted growth of *Schizothrix* in all exposed situations, whilst, wherever the embankment was more or less protected by an overhanging ledge, there was a dense tangled growth of *Stigonema* (near *St. minutum*, Hass.) exhibiting this characteristic film of air. Similarly, on the black rock which overshadows Dambulla, it is a species of *Tolypothrix* which presents this curious biological feature, being more or less restricted to patches protected by overhanging rocks. It forms greenish or bluish-green or almost white coverings on the rock-surface, having the appearance of fungal growth, the varying colour no doubt depending on the amount of associated air. The algal forms exhibiting this curious phenomenon, however, always show a peculiar incrustation on their sheath, which in one case was due to carbonate of lime, whilst in others it was unaffected by acids, and its nature is still unknown to me. One feels inclined to associate these incrustations with the retention of air, but what the relation between the two is, I am at present unable to say. In any case the air is held very tenaciously, for it has not been in any way displaced by the preserving fluid, which has now surrounded the material for three years.

Although probably advantageous from the respiratory point of view, tangled growth is not favourable to absorption of atmospheric moisture, and consequently we find that, wherever the air is humid, tangled growth sooner or later passes over into the third type—tufted growth (Plate I., D).* In a tangle only occasional filaments stand out to act as capillary threads for the absorption of water-vapour from the air, and consequently this type of growth requires a wet substratum. On a dry substratum water-provision cannot be adequate, and tangled growth will be unsuccessful. Moreover, if the atmosphere is damp, the water-vapour in the air will produce a hydrotropic stimulus, and a number of threads of the tangle will grow out vertically away from the substratum. These threads will eagerly take up moisture, and will exert a strong hydrotropic attraction on neighbouring threads of the tangle. The latter will wind their way round the already outstanding threads, so that a thick wick-like tuft is developed (cf. Fig. 1). And thus the commencement of tufted growth is established. One very often finds thick tufted growth arising from a slight basal tangle of the same species, although sometimes the basal tangle is quite indistinguishable. From the preceding remarks it will have been gathered that certain Cyanophyceæ may exhibit either tangled or tufted growth according to the external conditions; this is the case with species of the genera *Tolypothrix*, *Scytonema*, *Stigonema*, etc. In other forms, however (*Symploca*, *Schizothrix*), the tufted habit is the prevalent one, and most species of these genera do not exhibit much tangled growth, although in all cases there is probably a slight tangle at first. Such purely tufted forms generally settle down on a tangle of some other species (*e.g.* on a *Tolypothrix* or *Scytonema*, cf. Fig. 1).

Tufted growth, although at a distance indistinguishable from a tangle, gives

* Cf. also Fritsch, *Proc. Roy. Soc. London*, Ser. B, vol. 79, 1907, Fig. 1, p. 209.

a characteristic stamp when viewed from near at hand. When the tufts are closely placed (as in *Schizothrix*, *Tolypothrix*, etc.) we obtain a velvety appearance, recalling a thick and soft carpet, and such growth in the wet season is always saturated with water. In some species of *Symploca*, on the other hand, each tuft appears quite distinct from its neighbour, and the appearance is in striking contrast to that presented by the dense growth of such forms as *Schizothrix*. I am unable to say whether the varying types of tufted growth are due to conditions presented by the environment. But tufted growth in itself is certainly only developed under the conditions indicated in the preceding paragraph; in all dry localities (*e.g.* Anuradhapoora, Negombo), especially if both air and substratum are dry, we get practically no tufted growth except in particularly sheltered positions, whilst the wetter the district the more abundant does such growth become. Tufted growth is, indeed, a natural consequence of the moist heat of the tropics so familiar to all.

The assumption of tangled growth is thus probably due to the needs of respiration, whilst the appearance of tufted growth depends on the necessity of obtaining a better supply of moisture. The fourth mode of growth, which we will call the stratified one, is really only tufted growth which has developed in a certain definite way. The Alga concerned in the cases which I observed was generally some species of *Tolypothrix* or *Scytonema*, but it seems probable that other genera of Cyanophyceæ may also assume this habit. In the stratified mode of growth the tufts are arranged in definite strata one above the other, the tufts in each tier projecting out slightly beyond the tier above and showing a more or less marked downward inclination (cf. Plate II., D.; also at a few points in Plate I., D.). It is not of very common occurrence, and is found mainly on upright walls or tree-trunks in shaded situations. Such stratified growth, however, when developed, usually forms huge coherent sheets, which, with some care, may be detached as a whole (the photograph on Plate II. is made from a small portion of such a one). The appearance is very characteristic, reminding one of the growth of some Mosses. The essential feature of this habit may be a result of the shaded habitat or of the special conditions of moisture. In such extensive tufted growth on a vertical surface the individual tufts would considerably overshadow one another, but by the growth of the Alga in stratified layers, with each tier projecting well out beyond the one above it, this evil is somewhat remedied. In some cases the projecting portions of the tufts are of a different (brighter) colour than the inner shaded parts, and this points to illumination being in some way concerned in producing stratified growth. At the same time, it also seems comprehensible that if a large extent of tufted growth develope, it is advantageous for it to be arranged in downwardly directed tiers, so that each tier may catch up any drops of moisture (from rain), which run off the surface of the one above. Stratified growth is found mainly on substrata which do not furnish much water themselves, and hence it depends to a great extent on the supply of water from the atmosphere. I should think, however, that illumination plays the more important part in determining the stratified habit.

We may now pass on to consider, in slightly greater detail than has been done as yet, the mode of succession of these different types of growth, and the way in which they prepare the ground for higher vegetation; a few more words may also be said on the habitats in which they are customarily found. In the first place, we may note that the only truly successful forms in the subaërial algal vegetation of the uplands are the highly mucilaginous adhesive species, briefly discussed on p. 543. Tufted and tangled growth is rare, being practically absent on tree-trunks, where the Bryophytes and Lichens are too strong for them. Rocks are often without any algal covering, but tangles are sometimes developed on such substrata.

In the lowlands the hard smooth bark of many trees forms an unsuitable substratum for anything but adhesive growth. But in the wet regions, where there are very heavy downpours of rain, adhesive forms will find a difficulty in settling down on exposed substrata owing to the scouring effect of such rainfall. This probably explains how it is that even in very damp districts in the lowlands tree-trunks are often almost destitute of an algal covering.* Should adhesive forms, however, obtain a foothold, they may ultimately make the substratum suitable for tangled or tufted growth, as is not uncommonly seen where there is some protection from the action of the rain. Decayed trunks, of course, afford a much better base, and vie with an embankment in the richness of the algal covering. On such soft substrata, and particularly on an embankment, there is often no adhesive growth at all, especially if the surface is at all rough and crumbly. Tangled growth is very successful here, and since it undoubtedly helps to bind the clay of an embankment together, it will strengthen the latter to resist the effects of rainfall. Smooth objects such as walls, rocks, and some kinds of embankments are invariably colonized by adhesive growth at first, and this gradually prepares the ground for other forms.

The colonization of large smooth rock-surfaces seems particularly interesting, and I will describe a few observations made on the rock leading up to the tank at Nalande. The first forms to obtain a foothold are red-coloured gelatinous species (belonging to the genera *Glœocapsa*, *Aphanocapsa*) of the adhesive type (small Lichens are also important); these occupy every little crevice in the rock, giving its surface quite a red, granular, speckled appearance at certain points. These places serve as a centre for the growth of *Phormidium* (*P. laminosum* (Ag.), Gom.), another adhesive form, which develops huge thin papery films covering large portions of the rock-surface, as well as for small tangles of other filamentous species (chiefly *Scytonema*), which at diverse points constituted a slippery covering on the rock, making its ascent a by no means easy matter. In some cases the tangle of *Scytonema* was developed directly on the *Phormidium* as a base, or the latter bore a tangled growth of *Tolypothrix* from which very definite tufts arose. These tufts here and there even showed signs of stratification. Here we, therefore, have an interesting succession of the different types of growth, and these diverse forms undoubtedly have a slow but sure disintegrating action on the rock. In dry weather they shrivel up more or less, thus becoming detached from the rock-surface, and at the time of my visit (towards the end of the dry season) there were numerous detached patches, each with a small amount of soil adhering to it, lying about on the surface of the rock. In this way the latter is gradually prepared for vegetation of a higher type, although at most points matters have not as yet got beyond the stage described.

The stages in the colonization of walls are also often easily followed up, and two cases of this kind, noticed at Trincomalie and Kurunegala in Ceylon, may be briefly referred to. The wall at Trincomalie was an ordinary whitewashed one,

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* It may be pointed out, however, that the difficulties of colonization of a tree-trunk may vary very considerably with the nature of the bark. A furrowed bark must constitute a much more favourable substratum in most cases than a smooth one, and a great deal probably also depends on the absorptive capacity of the superficial layer of the bark for water. That the problem is not quite a simple one is shown by superficial observations on the distribution of *Pleurococcus* in our country. Thus, in a country lane not far from London, we have a more or less continuous row of roadside trees, consisting of pines and elms in almost equal numbers, with a few intermingled ashes. The trunks of the pines are completely destitute of algal covering, whilst a rich growth of *Pleurococcus* is found on most of the elms and ashes.

overshadowed by a luxuriant growth of trees, and was almost completely covered by a dense carpet of blue-green Algæ and Mosses, the former often growing in definite vertical lines corresponding to the drip of water from the trees above. Such dense algal growth is rather unusual in the dry northern half of Ceylon, and no doubt its exceptional occurrence in this case is to be accounted for by the sheltered situation of the habitat.* At the base of the dense tufts and tangles constituted by the main mass of the algal growth one could just detect remains of the adhesive forms (members of Chroococcaceæ), which had prepared the way for the subsequent vegetation. These were followed by a tangle of *Scytonema javanicum* (Kütz.), Born., which very soon, however, raised its filaments into tufts, and at many points along the wall these tufts showed a well-marked stratified arrangement. Here again we have all four forms of growth following in succession, but three of them are due to the same Alga (*S. javanicum*). At Kurunegala much the same was observed. At the base a tangle of dead filaments of a *Tolypothrix*, with an admixture of unicellular adhesive forms, probably the survivors of the first algal growth at these points. Above that, tangles of living filaments of the *Tolypothrix*, which in most places had passed over into a dense velvety covering composed of very uniform tufted growth. The latter had become colonized by a few small Mosses, which were being entwined by the filaments sent out by the basal tufts of *Tolypothrix*.† This is an exceedingly interesting relation, which was frequently met with, and requires a brief discussion. Small Mosses, or Liverworts, almost invariably settle down on the subaërial algal growth, as soon as the latter attains a certain degree of thickness, and may be seen as little bright green patches on the dark background formed by the Alga. These Mosses are always more or less saturated with water, and thus exert an attractive influence on the Alga below. Filaments grow out from the latter and wind their way round the Moss, and as their number increases the Moss of course tends to get smothered. Its only way of saving itself is to grow on in front, and thus escape the attacks of the Alga. The latter, however, slowly but surely follows up its advantage, and in this way a thick stratum of vegetable growth accumulates, forming a humus on which small ferns, etc., soon settle down. This process is probably of great importance in rapid colonization of a substratum. In some cases I have seen the same relation holding good between the isolated tufts of a *Symploca* and the basal tangle of a *Tolypothrix*, etc., on which it had settled down (Fig. 1), and here again the activity of the two forms no doubt leads to the accumulation of a considerable mass of algal substance in a relatively short space of time.

The arrangement of the algal growth on the wall at Trincomalie in definite vertical lines determined by the drops of moisture falling from the trees above is a common phenomenon, noticeable even on the tree-trunks, etc., in temperate regions, and particularly striking in some of the hothouses at Kew (cf. Plate I., B). The distribution of moisture, however, also determines other peculiarities of the mode of growth of the subaërial Algæ. In the case of rugged vertical surfaces (such as a rough wall) moisture, of course, collects most readily around the outstanding points, and these are the first to become colonized by algal growth. In sheltered situations this state of affairs often obtains for a considerable length of time before the whole surface becomes overgrown. On the other hand, if the rough surface be horizontal, we very frequently find small gelatinous colonies of one or more

* It is not quite impossible that the richness of this growth is also partially due to the neighbourhood of the sea. The presence of such a huge mass of water must lead to greater humidity of the air.

† Cf. Fritsch, *loc. cit.*, fig. 2.

unicellular forms settling down mainly in the excavations which receive most water (cf. what was said above about the rock at Nalande). These colonies are often not much larger than a pin's head, and in the case of a rock are so firmly lodged in the small hollows that they are not easy to remove. They form centres from which the growth extends outwards. The growth of epiphyllous Cyanophyceæ (see Plate II., A and B) also furnishes frequent examples of the importance of moisture for the growth of these forms. Thus in the case of the leaf of *Anthurium radicans* shown on Plate II., A, the Alga is evidently crowded into the lower portions

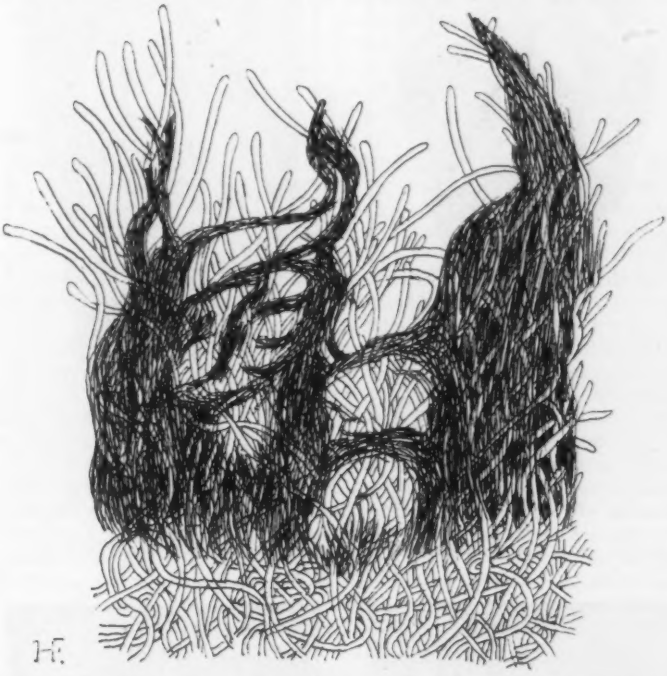


FIG. 1.—STRUGGLE FOR DOMINANCE BETWEEN A *TOLYPOTHRIX* AND *SYMPLOCA* (× 85 ABOUT).

At the base is a tangle of *Tolypothrix*, on which tufts of a *Symploca* (the dark shaded mass) have settled down. Numerous filaments arising from the basal tangle of *Tolypothrix* are winding their way round the *Symploca* tufts, almost completely covering them in some places. Note the way in which the tufts of the *Symploca* branch, the branches frequently contributing to the increase of neighbouring tufts. In the *Tolypothrix* only the sheaths of the filaments are shown.

(*i.e.* those nearest the drip-tip) of the channels formed by the deeply furrowed veins. These are the parts of the leaf-surface which are continually draining off the excess of moisture, and the latter comes to benefit the Alga concerned.

As an outcome of what has been described in the preceding pages we see that subaërial algal growth in the tropics gives its own peculiar character to the scenery in many regions, and probably plays a very important part in the progressive colonization of exposed surfaces. These Algæ, which so readily settle down on almost any object when the conditions of moisture and temperature are favourable, are

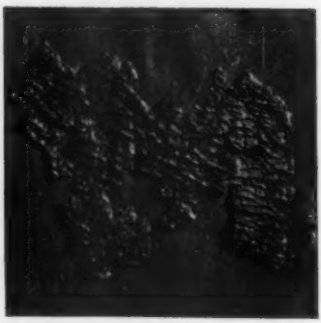
A

B

LEAVES FROM THE *NEPENTHES*-HOUSE AT KEW BEARING EPIPHYLLOUS[1] BLUE-GREEN ALGÆ.

C

TANGLED GROWTH OF ALGÆ ON A ROCK IN THE *NEPENTHES*-HOUSE, KEW.



D

STRATIFIED GROWTH OF A *TOLYPOTHRIX* ON TREE-TRUNKS, CEYLON.

PLATE II.

certainly in large measure the agents to which the tropics owe the wealth of vegetation on every available substratum. The rapidity with which colonization is effected is often striking. I remember, on my arrival in Colombo, noticing a newly whitewashed wall absolutely destitute of visible traces of algal growth. I passed this wall again less than a week later, and it bore a bright blue-green film of some *Oscillaria*, although still uncovered at many points. Three weeks elapsed before I again saw it, but now it was one blue-green film with practically none of the whitewash visible. Careful examination, moreover, showed that tangles were appearing at a few points. When I left the island about three months after my arrival, the wall was nearly completely covered by tangled growth, and at many points tufts had arisen, whilst small Mosses were already growing on the tangle. I am informed that in the damp hothouses at Kew newly whitewashed walls tend to become covered with a thin film of blue-green Algæ in about six weeks, although the length of time required varies according to the temperature and degree of moisture.

I am not sufficiently familiar with districts having a heavy rainfall in our parts of the world to say whether algal growth ever plays the same sort of part it does in the damp tropics, but I should think not, for the stimulating effect of the high temperature is wanting. Gelatinous adhesive forms may sometimes develop in quantity on a rock-surface, etc., when the latter for some reason is exceptionally moist, but I have never seen other kinds of growth in any amount. This tallies with the prevalence of gelatinous Algæ in the subaërial algal flora of the uplands of Ceylon (cf. p. 533), which, although they have a high rainfall, of course have a relatively low average temperature (mean annual temperature a little over 60° Fahr.). I hope, subsequently, to be able to study subaërial algal growth in damp regions in Europe, but for the present must refrain from further observations on this subject. No doubt the experience gained in the tropics will be of immense value in interpreting the problems presented in temperate regions, and the study of this subject could not have been commenced in a better field than is to be found in the damp tropics.

The Cyanophyceæ, in fact all subaërial Algæ, may be described as semi-aquatics. They still require more or less frequent saturation with water for successful development, and consequently they can only play an important part where the substratum is periodically very moist, or the relative humidity of the air high. Many subaërial Algæ have got over this difficulty by undergoing symbiotic combination with a Fungus to form a Lichen. Within the mycelial weft of the Fungus the Alga finds adequate protection from desiccation, whilst the Fungus is much better equipped to collect such moisture as the substratum may afford, and to pass part of it on to the Alga. And, consequently, the ordinary growth on rocks and tree-trunks, etc., in temperate regions is nearly always of the nature of a Lichen. Every one is familiar with the many-hued Lichen-covering on the rocks in the high Alps, etc., and much the same sort of growth is of course often to be seen on the trunks of our forest trees.

We may now briefly consider certain cases illustrating the *rôle* of aquatic Algæ in preparing ground for higher vegetation, but the data I have to offer on this side of the subject are, I fear, rather meagre. The action of such aquatic Algæ is in great part a manuring one, but in some cases, at least, they help in the accumulation of a soil or in the absorption of moisture, which comes to benefit the higher vegetation growing amidst them. Cases of this kind are described by Welwitsch and W. and G. S. West. The former * deals with the abundant occurrence of a

* Welwitsch, "The Pedras Negras of Pungo Andongo in Angola," *Journ. of Travel and Nat. Hist.*, vol. 1, 1868.

Scytonema (= *Porphyrosiphon Notarisii*) in the damp sandy upper valley of the Cuanza river (Angola). According to this observer, it "frequently extends across the wide meadows, closely spread like a net over the soil, intergrown with the other herbs and smaller shrubs. Through its hygroscopic nature, it eagerly absorbs the atmospheric moisture during the dewy nights, affording by this means a refreshing protection to the roots of many other and larger plants during the glowing heat of the following day. The growth and thriving of the numerous small Phanerogamous plants in these places is conditional on the co-presence of the prolific *Scytonema*." In citing this description of Welwitsch's, Messrs. W. and G. S. West* refer to analogous observations made by them on the sandy heaths of the south and some parts of the north of England. According to their account, "at the drier and hotter periods of the year, thickly matted sheets of *Zygnema ericetorum* are to be found extending over wide patches of almost bare sand, round such plants as *Drosera*, *Carices*, etc. These interlacing masses have great absorptive capacity, greedily taking up water; it is also highly probable that they protect and render the growth of other plants more possible by regulating the moisture of the surface soil. It is interesting to note that *Zygnema ericetorum* is found intermixed in small quantity with the *Porphyrosiphon Notarisii*, which covers such extensive areas in Angola." In both of the cases quoted, I think it probable that the Alga has an important manuring effect on the soil in addition to the other functions indicated.

I will, in the first place, describe a similar case from a salt marsh in the Bouche d'Erquy, in Brittany. Extensive vegetation-studies have been carried on during the past three summers at Erquy by the staff and students of the Botanical Department, University College, London, and in this connection certain observations of a preliminary nature have been made on the influence of the abundant algal growth on the colonization of new ground in the marsh. Scattered all over the latter are small pools of varying size—the pans. According to the level they occupy, these pans are more or less frequently overrun by the tides, and their water is consequently brackish. They harbour a rich growth of *Rhizoclonium* and *Lyngbya*, often intermingled with abundant colonies of *Chroococcus*, etc., and Diatoms; in some pans the *Rhizoclonium* predominates, in others the *Lyngbya*. The algal growth is often very thick, and when this is the case near the shallow edges of a pan, the algal weft, together with the mud and sand silted up between its filaments, gradually forms a soil on which *Salicornia* and subsequently *Suæda* settle down. In this way some of the pans appear to be slowly filling up, and are becoming populated by the neighbouring marsh-plants. It is not quite impossible that some of the pans themselves are due to the operation of the same sort of silting-up process on the tributaries of the river, which passes through the marsh. Moreover, in whole areas of the marsh the soil is rich in filaments of *Rhizoclonium* or *Lyngbya*, these filaments being more or less decayed and giving the sand or mud a dark black colour. The brackish Algæ at Erquy thus appear to play an important part, not only in the formation of new soil, but as humus-producers. In many parts of the marsh the *Rhizoclonium* also forms a bright green weft, covering the soil and ramifying through the superficial strata for long distances in a way evidently comparable to the cases described by Welwitsch and Messrs. W. and G. S. West. Such a covering probably affords an excellent moist substratum for the growth of the higher vegetation. Moreover, almost every tide will probably deposit a small amount of mud and sand on the surface of the Alga, and the latter will thus gradually become embedded. The buried portion will form humus by decay, whilst fresh branches from the Alga will continue the growth on the surface. The soil thus formed constitutes a black evil-smelling sandy mud, owing to the decomposing algal

* *Journal of Botany*, vol. 35, 1897, pp. 303, 304.

substance. Borings have shown that strata of a similar black sandy character are present at varying depths below the present level, and they no doubt testify to the occurrence of similar processes to those mentioned above at earlier periods in the history of the marsh.

We may next notice somewhat analogous phenomena recently described by W. G. Smith.* In dealing with the vegetation of sandy shores and sand-dunes in the botanical survey of Forfar and Fife, he mentions how "the hollows or troughs between the dune-ridges nearest the sea are sandy flats devoid of vegetation and still liable to inundation at high tide. When completely enclosed by protecting ridges, the dune-hollows become occasional pools of rain-water, where fine dust and organic materials collect. The catch-water has as its first vegetation evanescent growths of slimy blue-green and green Algæ, which aid in consolidating the bottom, and add to the organic matter till the soil is impervious enough to retain water throughout the winter and spring." This recalls Moss's description of the formation of moor-pan on the edges of many of the cotton-grass moors of the Pennines.† Such moor-pan is "initiated by the growth of slimy Algæ, of Lichens, of small Liverworts . . . on the bare earth and at the bases of the stems of the larger plants. . . . Over the remains of the pan-forming plants the creeping stems of heath-plants spread; and seedlings of the shrubby heath-plants also begin to grow." Both of these cases, though not directly comparable to the phenomena observed at Erquy, are parallel in their nature.

My friend, Mr. L. A. Boodle, has kindly drawn my attention to a very striking example of accumulation of algal growth leading to the production of a crust on the soil. This crust consists of a curious substance resembling elastic bitumen, and is found on the surface of the ground in South Australia. It is apparently derived by drying and other changes from an accumulation of gelatinous Algæ, Diatoms, etc. A similar deposit, which seems to be due to a member of the Cyanophyceæ, has been found in tropical Africa. I refrain from further discussion, as a description of these cases has just been published in the Kew *Bulletin*.‡ Earlier accounts of the Australian deposit are to be found in articles by W. T. Thiselton Dyer § and J. R. Jackson.‖

I made somewhat similar observations on some of the tanks or irrigation-reservoirs in Ceylon. During the dry season the water-surface often shrinks to a small fraction of its original area, and a large portion of the bottom of the tank becomes exposed. This latter appears as a soft black mud near the water's edge, but further away is hard and cakey, being traversed by cracks running in all directions. The softer portion often bears a considerable quantity of algal growth, which gets on well until this mud also dries up. The hard cakey part away from the water's edge always shows remains of algal growth, and its substance is generally found to be impregnated with algal filaments to some slight depth (1 or 2 inches). The surface, moreover, is often covered with abundant bleached remains of higher aquatics (*e.g.* at Lake Kantelai), so that this hard ground is well manured. In spite of this, it is only rarely found to bear a growth of higher terrestrial plants. This is no doubt due to the dried substratum and strong insolation of the tropical sun, against which there

* *Scottish Geographical Magazine*, vol. 21, 1905, p. 69.

† *Geographical Journal*, May, 1904, p. 10 (separate copy).

‡ L. A. Boodle, in 'Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew,' No. 5, 1907, pp. 145 *et seq.*

§ "On a Substance known as 'Australian Caoutchouc,'" *Journal of Botany*, New Ser., vol. 1, 1872, pp. 103–106. In this paper a number of similar cases are also mentioned (pp. 104, 105).

‖ "Coorongite, or Mineral Caoutchouc of South Australia," *Pharm. Journ. and Trans.*, 3rd series, vol. 2, 1871–72, pp. 763 *et seq.*

are no means of protection. In some few of the tanks, however, the height attained by the water-level in the wet season is decreasing for some reason or other, and certain portions of the bottom near the edge of the tank are permanently exposed. These ultimately become colonized by quite a rich growth of land-plants, which no doubt by their progressive advance are able to overcome the difficulties of a dried substratum and intense insolation, and find favourable conditions in the well-manured soil. Similar phenomena on a smaller scale are common enough in Ceylon.*

In our parts of the world the same thing may be seen in the gradual encroachment of marsh-plants on a piece of water.† Sinking of the water-level, of course, always takes place in a hot summer, and if the water concerned is shallow, a certain amount of the bottom will become exposed. The area thus exposed, however, is not subjected to such extreme conditions as obtain in the tropics; especially if a considerable mass of water-plants is left by the retiring water, the exposed strip will tend to remain somewhat marshy in character, and will therefore be invaded by marsh-plants. If exposure is sufficiently long to enable the latter to obtain a proper footing, most of them will hold their own even after the return of the water. The growth of water-plants, and more particularly of filamentous Algæ, between the bases of the stems of these marsh-plants and the sediment washed in amongst the former will gradually cause silting up, and the marsh will become more pronounced. Of course, it frequently happens that a considerable rise of the water-level takes place, and makes matters impossible for the marsh-plants, which then have to retire to their own ground. Good examples of this kind may be seen on Sheen Common, Richmond. A number of the small pools there show a constant struggle between the water and these marsh-plants, resulting now in the victory of the one, now in that of the other; but, as far as I can see, in this case it never leads to an end.

One of these pools on Sheen Common shows another phenomenon, which is of interest to us here; and I was able to study several examples of the same kind in Ceylon.‡ I refer to the formation of deposits of reddish-brown hydroxide of iron, which often accumulates in very considerable quantities on the bottoms of pools, whose waters contain a certain amount of dissolved iron salts. There is a remarkable uniformity in the algal flora of such pools, which are characterized by containing an often very abundant Conjugate flora (species of *Spirogyra*, *Zygnema*, *Pleurotænium*, *Closterium*, *Netrium*), as well as forms like *Œdogonium*, *Ulothrix* and Diatoms (species of *Pinnularia*, *Navicula*, *Surirella*, *Synedra lunaris*). The filamentous Algæ and larger water-plants occurring in these pools are generally found to have their filaments coated by a granular or filmy covering of this ferric hydroxide, so much so that they are often completely obscured. There seems no other way for accounting for this investment than by assuming that it owes its presence on the surface of the plant-growth to the metabolic processes of the latter; probably the dissolved iron salts in the water are oxydized by the activities of the plants, and are then precipitated as insoluble ferric hydroxide.§ As the latter accumulates it will sink down to the bottom of the piece of water, thus giving rise to a characteristic

* A very striking case (that of Lob Nor in Central Asia) of an analogous kind is mentioned on pp. 462, 463 of the *Geogr. Journal*, vol. 27, 1906 (discussion by Sir T. Holdich of Scott Elliot's paper).

† Cf. Pawson, "Water-plants as Land-winners," *Naturalist*, No. 511, 1898; also, Moss, *loc. cit.*, p. 6 (separate copy).

‡ Cf. Fritsch, *Proc. Roy. Soc. London*, Ser. B, vol. 79, 1907, Sect. *b* (ii.), pp. 236 *et seq.*

§ Similar deposits are known to be formed as a result of the activity of iron-bacteria. Such Bacteria may also to some extent be concerned in the case described, although in early stages at least, they were not found to be present. Cf. also Hanstein, in *Sitz. ber. d. Niederrhein. Ges. Bonn*, 1878, pp. 73–75.

granular deposit. The plant-growth in the water, moreover, as it dies away will fall to the bottom, and bring a further mass of reddish-brown hydroxide with it. In Ceylon I observed many different pools suggesting different stages in this process. Some had no bottom-deposit at all, but merely a red flocculent or filmy covering on the aquatic vegetation; in others there was a certain amount of deposit in addition to an abundant covering on the plant-growth. The final stage is found in pools with a thick red deposit all over the bottom, but little or no macroscopic plant-growth. It appears as though extensive accumulation of the deposit leads to unfavourable conditions for the continuance of vegetation, although in the absence of consecutive observations of the same pool it is difficult to say whether this is a passing phase or not. In the Sheen Common pool above mentioned accumulation of the red deposit is going on steadily, and has at sundry times appeared to have a very depressing influence on the algal vegetation, although as yet the latter has generally managed to recover. I hope to be able to study this interesting subject in greater detail subsequently; a few more facts about it are contained in my general paper on the Algæ of Ceylon (*loc. cit.*).

Such deposits must, of course, involve a gradual shallowing of the piece of water, and from this point of view they interest us here. We have the formation of a peculiar kind of soil as a result of algal activity.

Finally, I desire to briefly refer to an interesting occurrence of terrestrial Algæ on the seashore in many parts of Ceylon.* On the sandy spit which fringes in the lagoon at Kalutara, large quantities of a foliose *Nostoc* are to be found lying loosely on the sand amongst the numerous fruits (some of them, e.g. *Cerbera*, *Otodes*, had germinated and formed seedlings) cast up with the drift. At Bentotta and Matara the same form is found on the sand of the seashore above high-tide level. It lies loosely on the shore, and at a first glance is difficult to distinguish from the dead blackened leaves of the *Ipomœa Pes-Capræ*, which grows in abundance in the same locality. It appears that this *Nostoc* favours a sandy substratum, for it was found in quantity in the coconut plantations at the back of the beach as far as the sandy soil extended, and was also met with about 2 miles inland near the Bentotta river—again growing on sand. This species has markedly xerophytic characters, which are in keeping with its habitat. The colony is surrounded by a tough outer sheath, which does not swell up in water, and each of the contained filaments has a fairly compact yellowish sheath of its own. Its only source of water can be atmospheric moisture in the form of dew or rain, and hence the necessity for adequate protection from desiccation in the form of thick sheaths. The point that interests us most here is the possible important manuring effect of this abundant form, large masses of which are often found to be overgrown by the *Ipomœa*. It may also, by the absorption of atmospheric moisture, play much the same part as the Algæ described by Welwitsch and the Wests in supplying moisture to the plants of the tropical sandy shore.

In concluding this paper, I should like to point out that many of the phenomena dealt with are readily observed, and do not require protracted investigation. It would be highly valuable if travellers would devote a little attention to such features, and would contribute data as to their distribution and relative importance in different regions of the Earth.†

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* Cf. also Tansley and Fritsch, "The Flora of the Ceylon Littoral," *New Phytologist*, vol. 4, No. 1, 1905, pp. 13, 14.

† Many of the results recorded in the present paper were obtained with the help of a grant from the Government Grant Committee of the Royal Society, to whom I am much indebted for the assistance thus offered me. I should also mention that Fig. 1 is the work of my wife.

Description of the Plates.

Plate I.—Photographs illustrating the colonization of bare surfaces by subaërial Cyanophyceæ in the hothouses of the Royal Botanic Gardens, Kew. A, dense gelatinous adhesive growth on north wall of Aroid house; tangles are appearing at a number of points. B, adhesive growth on wall in tropical fern-house; the growth consists of large gelatinous masses of *Nostoc* and *Glæocapsa*. C, colonization of a rock-surface in the *Nepenthes*-house. Dense tangle of a *Scytonema*, covering an adhesive base (not visible), the tangle being overgrown by young ferns. D, tangled and tufted growth of blue-green Algæ on walls in *Nepenthes*-house.

Plate II.—A, photograph of a leaf of *Anthurium radicans* from the *Nepenthes*-house at Kew, bearing a dense growth of epiphyllous Cyanophyceæ; the Alga is mainly present in the furrowed veins in the upper half of the leaf. B, leaf of *Nyrosma kummeriana*, bearing numerous rounded patches of epiphyllous Cyanophyceæ (*Nepenthes*-house, Kew), which appear as dark areas. C, typical tangled growth of a *Scytonema* on a rock in the *Nepenthes*-house at Kew. D, portion of a sheet of a stratified *Tolypothrix*, found on tree-trunks, Ambalangodda, Ceylon.

REVIEWS.

EUROPE.

Physical History of Devonshire.

'The History of Devonshire Scenery.' By Arthur W. Clayden. London: Chatto & Windus. 1906.

There are few counties in England which possess a more varied succession of rocks than Devonshire. They range from Lower Devonian, at least, to Pleistocene, and probably among the schists of the Start and the slates of North Devon formations older than the Devonian may be represented. Mr. Clayden has set himself the task of depicting the changes through which the county has passed in such a way as to make them intelligible and interesting to a reader not specially versed in geological methods. He is intimately familiar with much of the field evidence, and knows how to direct his readers to the localities where they may find for themselves the proofs of his assertions. The book, moreover, is adequately illustrated with reproductions from photographs, and with a limited number of maps. To those who know the district this volume is full of charm, and geologists must praise the lucid and vigorous treatment which the subject receives at the author's hands. Of course, there is much that is obscure and controversial in the past history of Devonshire, and these difficulties are not to be avoided, but they are not allowed to obtrude themselves unduly on our notice. The later chapters are devoted to the origin of the present scenery, the history of the river-valleys, and their relations to the earlier plateaux which form so well-marked features of the general landscape. From all Devonians and all who have made or are to make a tour in Devon this work well deserves a careful perusal. It is evidently the fruit of years of special study and of a close acquaintance with the results of geological investigation in the west of England. J. S. F.

A Corner of Devonshire.

'The Hills and Valleys of Torquay.' By A. J. Jukes-Browne. Torquay: published by the Author. 1907.

In Mr. Jukes-Browne's latest work we have a complete little monograph of the scenery of a small but intensely interesting corner of England. The geological

structures around Torquay are complex, and the rocks have been much faulted. The older plateaus have been deeply incised by modern river-valleys, and these last have passed through several stages of development before attaining their present condition. The interest of the problems examined is mostly of a strictly local character, but larger issues lie behind. Possessing a ripe knowledge of English geology and wide experience in the field, the author leads us from the local phenomena to questions of British geological history. The book is meant chiefly for visitors to Torquay, and is illustrated by large-scale maps from actual survey. No one can read it without seeing how complicated are the problems raised by the surface configuration of even a very limited area, and how much useful scientific work can be done by those who are prepared to devote their leisure to an analysis of the causes which have produced some of our most familiar landscapes.

J. S. F.

Macedonia.

'Makedonische Fahrten. I. Chalkidike.' By Adolph Struck. *Illustrated.* Pp. 88. Vienna and Liepzig: A. Hartleben's Verlag. 1907.

This is the fourth part in the series edited by Dr. Carl Patsch, of Serajevo, 'Zur Kunde des Balkanhalbinsel,' and the first contributed by Dr. Adolph Struck, who fills the office of librarian in the German Institute at Athens, and has travelled much in Macedonia. The author's object has been archæological, and we do not gather that he claims any cartographical knowledge. The chart appended to his description is based on the well-known Austrian staff map. The volume contains a running description of routes and stations, based on a journey which showed the author all the Chalcidic peninsula except its easternmost prong, the Holy mountains, already sufficiently well known. There are notes on points of history and ancient topography; but in the main Dr. Struck gives a superficial description of the gazetteer or guide-book kind.

ASIA.

Armenia.

'The Geology of Armenia. By Felix Oswald, B.A., D.SC. Beeston, Notts.: published by the Author. 1906.

This work deserves a warm welcome, not only as a contribution to geological literature, but also as an example of self-help in the world of scientific work. The author accompanied Mr. Lynch in his travels in Armenia in 1891, and the first part of this book, consisting of the geological results of that expedition, was originally prepared as a thesis for the University of London. The second portion is a summary of all that is known at the present time of the geology of Armenia. With the palæontology he has had the help of specialists in the British Museum, but the numerous petrographical notes and the geological descriptions have been prepared by himself. In one respect the book is probably unique: it has been printed and published by the author. The illustrations are also his own work, and are reproduced by the autocopyist or some similar process.

The account of the special geology of Armenia is prefaced by an account of the relations between this portion of Asia and the adjacent continents. Armenia is regarded as a plateau or syncline lying between the upfolded Taurus and the Pontic ranges. It is held to be homologous with the high tableland of Tibet, and its bounding ridges correspond to the Himalayas and the Kuenlun mountains. The main structural lines of the country have an east-and-west direction, which finds expression in the orientation of the mountain chains, such as the Taurus, the Karabagh, and the Shatin Dagh. The principal folding appears to have taken

place in Mesozoic and early Tertiary times, and the author believes that the post-Miocene movements which gave the Caucasus its present importance produced little plication in Armenia. The tableland, already folded, was now fractured into blocks bounded by faults which have usually the same trend as the Caucasus. These faults traverse the older systems of folds, and along them great volcanic outbursts have taken place.

The Armenian plateau is covered with volcanoes, some of them probably not yet extinct. The most noteworthy of these lie along a line which Dr. Oswald regards as a continuation of the fissures which pass through the Jordan valley and the Red-sea depression into the rift-valley of Africa. Nimrud, Sipan, Tandurek, and Ararat are all placed upon this line. Nimrud is one of the most interesting volcanoes of Asia; its last eruption was in 1441. Dr. Oswald is the first scientific man to give an accurate account of it; his sketches, maps, and geological sections enable us to form a very clear idea of its appearance and geological structure. The crater, which contains a lake, is nearly 5 miles in diameter, and is one of the largest known. The mountain rises about 4000 feet above Lake Van, and the crater is about 2000 feet deep. Within it there are many lava-flows, and in its southern portion a new crater (1½ mile in diameter) has been formed. The petrographical descriptions show that olivine basalt, trachyte, rhyolite, and obsidian have been emitted by this vent. The country around Nimrud has been flooded with extensive sheets of basalt; these cross the plains and form a dam 670 feet in height, holding up the waters of Lake Van. They entered some of the existing river-valleys and partly filled them—a fact which proves how recent these eruptions were. Violent earthquakes still take place in this district; one occurred on May 30, 1881, destroying a village which stood at the base of the crater wall.

The second part of the book provides a useful conspectus of the available information on Armenian geology, and is completed by a bibliographical appendix. The work is in every way an important contribution to the geology of Asia, and will serve as a standard work of reference for many years to come.

J. S. F.

AFRICA.

The Ethnography of Central Nigeria.

'Le Plateau Central Nigérien: Une Mission Archéologique et Ethnographique au Soudan Français.' By Lieut. Louis Desplagnes. Paris: Emile Larose, Rue Victor Cousin.

This French study of the ethnography of the Central Niger—that is to say, of the region lying to the north of 13° N. lat., east of Senegambia, south of the Sahara desert, and west of Sokoto—is, to use a very hackneyed phrase, epoch-making. So little of real scientific value has as yet been written and published on the ancient and modern races of Africa, that this work is likely to be remarkable. It can only be compared with the studies of Schweinfurth, Bleek, Delafosse, Flinders Petrie, Barth, Duveyrier, Nachtigal, Révoil, Foureau, Xavier Stainier, Dr. Hamy, the anonymous authors of 'Notes Analytiques sur les Collections Ethnographiques du Musée du Congo;' of Koelle, Fülleborn, Binger, R. N. Hall, and of George Stow, author of 'The Native Races of South Africa.'

It is sad to note that only three of these names are English, and that England, as compared to France, Germany, Belgium, and Italy—even Portugal—has made so little use of her opportunities as the power with the greatest amount of African territory under her control to investigate the past history of man in Africa, especially in the regions outside the Mediterranean basin.

Had this book been published in England, instead of being sold in one volume

at the modest price of ten shillings (illustrated as it is with 119 admirable photographs and an excellent map), it would have been made up into two heavy volumes, and priced at twenty-five shillings, or some other figure much beyond the resources of most African students. This is a work which will be largely quoted from, with or without acknowledgment. It is the first serious study of the ethnography of western Nigeria. It commences with a geographical and mineralogical study admirably illustrated. By this we are enabled for the first time to realize the extraordinary scenery of the Hombori or Tombori region, first revealed to us by Barth, whose little sketches, primly reproduced in woodcuts, of the fantastic mountain scenery seemed too extraordinary for belief, though they are now to a great extent borne out by Lieut. Desplagne's photographs. These illustrate not only the natural columns, the fingers, spikes, sugar-loaves, and plateau walls of the mountainous region lying between the Niger of the Hausas and the Niger of the Mandingos, but they also reproduce for us the flooded plains, the palm-crested hillocks, the wide rivers and reedy lakes of the lacustrine region of the western Niger. From these and from the map we are enabled to realize that at no very distant period the upper Niger and its affluent the Bani must, when they descended from the mountains of Liberia and Senegambia, have fed a vast shallow lake, three or four times the size of the Victoria Nyanza.

Delineating the vast human history of this region from the collection and comparison of records and traditions, and, above all, from the prehistoric remains, the author of the book deduces that the first human inhabitants of western Nigeria were yellow-skinned Pygmies, apparently (from the description given) resembling some of the Pygmy races existing in the Congo forest to-day, or the Pygmies still lingering in East Africa, even, it may be, the Pygmy races of South-West Africa. Into this country then came big black Negroes from the east, following especially the course of rivers—negroes of the tall, long-legged Nilotic type, and "forest" negroes of the burly, short-legged variety. Then, after an interval, "neolithic" races of the Caucasian species arrived from the north, and also from the east. Apparently, the first of these Caucasian invaders was a shepherd race, akin to the modern Fulas; a race that must have brought with them most of, if not all, the domestic animals which existed in this and in other parts of Negro Africa prior to the coming of the Portuguese or the Arab—that is to say, the dog, ox, goat, and sheep. Whether these primitive Caucasians of a Fula-like type were identical with the neolithic people that ranged across North Negro-Africa from Senegambia to Somaliland, the author and his commentators are not quite decided. In some passages Lieut. Desplagnes speaks of the Fulas as a non-progressive people who have been and are little else than herdsmen, a race that has never lifted itself out of the pastoral age, which may have to a great extent preceded that in which neolithic weapons or the working of metals were invented.

It may be noticed, in passing, that Lieut. Desplagnes, far reaching as his researches are, does not seem to have sufficiently grasped the main features of the Fulu language. He repeats without disapproval the somewhat fantastic theories based on the writings of Sultan Bello, that the Fulas came direct and at no very distant period from the east—from the Red sea; that they are even an Asiatic race. Sultan Bello's fragment of historical notes, which was brought home by the traveller Clapperton, is really of very little value to serious students of Africa. It is a jumble of more or less nonsensical traditions derived from the Koran or from Arab legends. The oral traditions of Negroes and Negroids are not underrated in their importance by the present writer; they may often give a clue to the past history of the race. At the same time they may be easily disturbed and falsified by the influence of a superior invading race, or warped by the unscientific guess of

some native philosopher. Races who declare themselves to be the autochthones may not have been in their present habitat for more than three hundred years. Others, again, who ascribe to themselves descent from an Arab invader or Jewish monarch may have been living more or less where we now find them for ten thousand years.

In *language* the Fulas are connected with purely Negro races living here and there in the West African hinterland, and also, much more distantly, with the fundamental stock of the great Bantu family. Corporeally, they are closely related to the Ethiopians, to the Galla aristocracy in eastern Africa, even to some of the earlier non-Negro races of Egypt. They are, of course, largely impregnated with Negro blood, as are all the races of Africa, not even excluding the Berbers of the north. They are, in fact, more properly classed with the Negro than with the Caucasian, though they are nearly a half and half mixture between the two types. Evidently they and many other Ethiopian and North African races represent the earliest mixture between the invading Caucasian from the Mediterranean basin and the primitive big black Negroes of tropical Africa. As to the relations in history and origin of the big black Negro type and the yellower Pygmy negro, science has not yet pronounced her decision. At any rate, prehistorically, the two types seem to have co-existed and to have frequently fused. At the present day the black Negro type seems to be divided into two main stocks (suggests Lieut. Desplagnes, in interesting conformity with the views of other writers, of which he may not be aware)—the burly, short-legged, long-armed type (once described by the present writer as the "forest" Negro), and the long-legged, less prognathous Nilotic Negro. The first race is more associated with the forests, and the latter with the plains and the shores of lakes and rivers. The Nilotic type, so characteristically developed in the upper Nile valley, stretches right across North-Central Africa to Senegambia, and also southwards, in various degrees of intermixture with the Bantu peoples of Southern Africa.

Lieut. Desplagnes indicates in his human history of Nigeria that after the Dwarfs and the black Negroes were succeeded and supplanted by a primitive Caucasian type (the Fula), there arrived other and more important invasions of the Libyans from the north, of people allied to the modern Berbers. These invasions began far back in the periods coincident with civilized Egypt, and have, as we know, continued down to the present day, and have been to a certain extent further influenced and reinforced by the extension of Arab influence in the centuries which succeeded the uprising of Muhammadanism. Some of this Arab influence reached Nigeria from due east. Much of it, however, came from Morocco, Tunis, and Tripoli. Somewhere about the thirteenth century commenced the subjugation of western Nigeria by the Mandingos, at first by a section of these people, seemingly identical with the modern Susus. This Mandingo invasion of Western Africa, according to tradition, was associated with the riding of horses, and came from the far east, from the direction of Hausaland.* These Mandingo clans swept

* The author of this book points out a fact (which is easily confirmed by reference to comparative vocabularies) of the almost universality of the root meaning "horse" amongst all peoples speaking Mandingo languages, and he suggests an Egyptian origin for this term for horse, as though the horse had reached eastern Negroland from Egypt, carrying with it an Egyptian designation. Another point, to which he makes no reference, is the resemblance in the negative particle, and in some numerals of the Mandingo languages to roots for the same concepts in the Nilotic Negro tongues, the influence of which extends westwards nearly as far as the Shari river. Mandingo civilization also is emphatically Bantu, as though this

across the bend of the Niger at the back of the forest region and established themselves once and for all in western Nigeria. Their power lasted more or less till the invasion of the Moors in the seventeenth century, and the uprising of the Fulas in the eighteenth.

This is a very rough summary of the careful and elaborate studies and theories of Lieut. Desplagnes. It is very difficult in a review to do justice to a work written with so much care and detail, and one which here and there faces us with rash conclusions and dogmatic assertions. These command attention, though they may not always obtain belief. Lieut. Desplagnes attaches perhaps too much importance to the traditions collected and transmitted by classical writers on geography—Herodotus and Pliny—and his insufficient acquaintance with African languages makes him in this respect too uncritical. But the positive knowledge accumulated and recorded by himself is worthy of high praise.

H. H. Johnston.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Steppe Denudation.

'Denudatsiya Stepi.' A. Ivchenko. In three parts. St. Petersburg: Typographia I. N. Skorokhodova. 1906.

The author travelled over the steppes of Russian Central Asia in the years 1902 to 1905, and contributed these papers, detailing the results of his investigations, to the annual of the Russian Geological and Mineralogical Society. The climate of the steppe is similar to that of the sandy deserts, but the extremes are less marked. The rainfall is three or four times as great, amounting on the grass steppe to about 5½ inches, and the cloudiness is also much larger. The range of temperature of the air does not differ materially in the two regions, but the range of temperature on the soil is especially large in the deserts. The prevailing north and north-west winds increase in violence towards the south. Hence the character of the denudation differs in the steppes and in the desert. In the former, where the precipitation is greater, erosion plays a more important part, especially where elevations—even those of no great height—arrest some of the scanty moisture of the air, while in the deserts isolation and deflation are the predominating agents, and there are fewer obstacles to the formation of sandhills and *barkhans*. M. Ivchenko gives a very minute description of the various forms of denudation in different parts of the steppe and their relation to the climate and geology. He includes also some notes on the flora and fauna.

In the concluding chapters M. Ivchenko asserts that the prime cause of the formation of deserts and steppes is the form of relief—a basin, isolated or more or less open to the sea—and that climate and other agencies are of secondary importance. This seems a strange theory. The first essential for the existence of deserts and steppes is a small rainfall and excessive isolation owing to the absence of clouds, and these depend on the distribution of land and water and the consequent circulation of the atmosphere. Russian Central Asia is exposed to the dry north-westerly winds, while the monsoons of the Indian ocean are diverted by the huge elevated mass of the Himalayas. The Amazons basin, with its outlet towards the rain-bearing winds of the Atlantic, is abundantly watered, while German South-West Africa, rising directly from the ocean, is the driest part of West Africa south of the Sahara.

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conquering race had come from some Central African home wherein had been developed at much the same period, and also under Nilotic or Hamitic influence, the Bantu language type and the Bantu civilization, which was to overspread the southern half of Africa to Natal, to Zanzibar, and to the Congo.

GENERAL.

Economic Statistics.

'Die Weltwirtschaft: Ein Jahr-und Lesebuch.' Edited by E. von Halle. Three parts. Leipzig and Berlin. 1906.

The three parts or volumes (for they are separately paged) published under this title form the first year's issue of what is intended to be an annual publication, giving statistical and other data bearing on the economic condition of the principal countries of the world. The first part gives international surveys on economic policy, social policy, the production of food-stuffs and raw materials, the money market of the world, commerce, the means of communication, insurance, etc. The corresponding part of the second year is already issued. The second part is entirely devoted to Germany, and the third deals with other countries separately. In each part the different chapters are by specialists. Much of the information contained in these volumes will be of great use to geographers, though the work is mainly designed for economists and statisticians, no attempt being made in the work itself to deal with the facts contained in it from a geographical point of view. How far that point of view is from the minds of the writers may be judged from the fact that even in the volume on Germany there is no systematic statement of the localities in which different industries are carried on. Thus under "jute" there is not the slightest hint as to the principal seat or seats of this industry in Germany; under "linen" there is only an incidental mention of a wages agitation in the Berlin and Bielefeld districts; under "cotton" only an enumeration of spindles and looms by political divisions (states and provinces), and so in other cases.

G. G. C.

A Geographical Dictionary.

A. Demangeon, 'Dictionnaire de Géographie.' Paris: Amand Colin. 1907. *Price*, 6 *francs*.

This compact volume, composed of 860 pages of small type, or rather types, in double columns, is for the most part a general gazetteer; but over and above that is a dictionary of persons distinguished in connection with geography, and one of terms used in every branch of geography, including not merely definitions of terms, but brief expository statements. The scope of the work under this latter head may be indicated by mentioning that it contains brief articles under *aberration* (of light), *abîme*, *ablation glaciare* (in the sense of the melting of glaciers), *abyssal*, *acacia*, *acadien* (in geology), *acclimatation*, *altération* (dealing with changes in rock structure due to the action of water, air, sun-heat, frost, etc.), *altitude* (with an account of its influences on atmospheric pressure, on temperature, and on precipitation), *alumine*, *aluminium*, *alun*, etc. All the headings belong to one alphabetical arrangement. There are numerous sketch-maps and other illustrations. Oversights of one kind or another of course occur, but the work appears to be on the whole well done, and is likely to be very useful.

G. G. C.

Geographical Terms.

Lucien Hoebsteyn, 'Les Termes de Géographie dans les langues du globe. Brussels Misch et Thron. 1907.

One cannot but regret the large amount of labour that has been almost entirely wasted in the preparation of this volume, at any rate in the form in which it is now published. The terms of geography are arranged in alphabetical order in the French language only, and there is no means of finding the meaning of a term in

any other language unless by the merest chance one drops on the required entry amongst thousands of others. Under *colline*, for example, one finds the equivalent in more than 150 languages, including the Taungtha, Welaung, Esperanto, etc.; but if one meets with the Taungtha name for "a hill," there is no index to aid one in learning the signification from this book. Moreover, if one may judge from the English equivalents that are given for the French terms, one cannot but be doubtful as to the accuracy of the equivalents in other languages. The English equivalents given for *colline* are exactly as follows: "cashion-shaped, doune, down, hill, hillock, hummock, knock, knoll, knowl, neck, meal, and slope." In some cases the foreign equivalent appears to have been arrived at by a very reckless use of dictionaries. Thus, for *croupe*, which is defined as "*le sommet arrondi d'une montagne*," the English equivalent *crupper* is given, which is indeed the equivalent for that meaning of the term *croupe* which has suggested the geographical sense, but which has no such geographical use in English. A more extraordinary instance is found under *albarède*, which is defined as a "*plantation d'aubiers*" (guelder-rose trees), and for which the English equivalent "bleak district" is given. This seems to have been arrived at in this way: The ordinary meaning of *aubier* is "alburnum," or "sapwood," for which an old and little used term is "blea" and perhaps "bleak." "Bleak," at least, is given in French if not in English dictionaries in that sense, and the author has added "district." There would, at least, be some value in the book if it were a complete list of French geographical terms with their meanings; but this it is not. The author appears to have understood "geographical terms" in a peculiar sense, which makes it difficult to understand his criterion for admission and inclusion of terms. *Bataille*, *bleu*, and other names of colours, the names of plantations of different kinds of trees are all included; but such terms as *atmosphère*, *cumulus*, and other names of cloud forms, *faille*, and other geological terms, are excluded. *Alluvion* and *limon* are both entered and defined, but there is no entry of *falun* (a deposit of sea-sand and sea-shells), a term much more likely to be sought for by those who consult a dictionary of this sort.

G. G. C.

SHORT NOTICES.

Asia.—'The Truce in the East and its Aftermath.' By B. L. Putnam Weale. (London: Macmillan. 1907. Pp. xv. and 645. *Maps and Illustrations.*) This is another of the political studies through which Mr. Weale's pen is well known; it is, in fact, a sequel to his 'Reshaping of the Far East.' The book is in the main a political prophecy; from the strictly geographical standpoint, it may be mentioned that the author maintains his policy of furnishing a few descriptive paragraphs (such as that dealing with a journey along the military railway in Korea), which undoubtedly add intelligibility to the work at large. The large map of the Far East must have undergone considerable revision in its time, but it would bear some more. The sketch-map showing the boundary between the "zones into which Manchuria is now tacitly divided" is interesting.

Africa.—'The Egypt of the Future,' by Edward Dicey (London: Heinemann. 1907. Pp. 216), is another political prophecy and sequel to a previous work—not, as in the case of the book just noticed, lightened by geographical description. The author contrasts Lord Cromer's system of government in Egypt with his own ideal.

America.—'Recent Hunting Trips in British North America.' By F. C. Selous. (London: Witherby. 1907. Pp. 400. *Illustrations.*) The famous African sportsman here describes his hunting expeditions into new fields—Central

Canada, the district of the upper Yukon, and Newfoundland. There are among the photographs a few admirable landscapes.

'Four Centuries of the Panama Canal.' By Willis Fletcher Johnson. (London: Cassell. 1906. Pp. xxi. and 461. *Maps and Illustrations.*) The author certainly begins at the beginning. The title mentions four centuries, but at p. 7 we have a map—no more successful than most American cartography—of the world according to Ptolemy. But it is an interesting and well-told story, given with full and circumstantial detail, and the importance and value of such a history may increase as the work on the canal progresses. There are abundant incidental notes on the character and resources of the Isthmian region.

'Notes upon the Island of Dominica.' By Symington Grieve. (London: Block. 1906. Pp. 126. *Map and Illustrations.*) This account of Dominica is written mainly from the point of view of intending settlers, but with a liberal interpretation of their interests, so that it forms a useful general work of reference on the island.

Historical.—'Voyages of the Elizabethan Seamen.' Edited by E. J. Payne, with additional notes by C. Raymond Beazley (Oxford: Clarendon Press. 1907. Pp. lxii. and 415. *Maps and Illustrations*). This excellently produced handbook contains annotated narratives of voyages of Hawkins, Frobisher, Drake, Gilbert, and others, adapted from the originals, together with an introduction surveying the circumstances under which these voyages were undertaken, and the life and works of Hakluyt. One of the maps (North America, Greenland, etc.) is taken from Hakluyt, and the whole book is well calculated to present these pages of history in their proper atmospheres.

'A Sea-Dog of Devon,' by R. A. J. Walling (London: Cassell. 1907. Pp. xii. and 288. *Frontispiece*), is a clear narrative of the life of Sir John Hawkins, which fills a gap in books of this kind. If the author's many colloquialisms do not always command admiration, at least the whole spirit of the story tends to justify them. Mr. Walling is devoted to his subject, and inspires his reader also. The half-tone from an original family portrait of Hawkins is worth notice.

'The Real Sir Richard Burton.' By Walter Phelps Dodge (London: Fisher Unwin. 1907. Pp. 240. *Frontispiece*). This biography enters into the study of a remarkable character (or rather two, for Lady Burton figures largely) with intimacy. The book is readable, though it gives an impression of sketchiness, perhaps owing to the extensive use of very brief paragraphs. Some of the spellings of place-names may be thought needlessly unfamiliar—the "Neilgherries," for instance; and it is hardly fair treatment of an early geographical discovery to say that Burton, on sighting Tanganyika, was tempted to shout, *Thalatta, Thalatta!* "like Xenophon."

'The British Army under Wellington, 1813–1814,' by T. Miller Maguire (London: Clowes. 1907. Pp. 50), is a reproduction of articles in the *United Service Magazine*, embodying lengthy extracts from Wellington's 'Despatches,' and illustrated by several valuable maps.

General.—'L'Or dans le Monde,' by L. de Launay (Paris: Armand Colin. 1907. Pp. xxi. and 265), is a useful synopsis of the problems connected with gold—its geological occurrence and geographical distribution, the methods of its extraction, and the economic status of the metal.

'Imperial Outposts,' by Colonel A. M. Murray (London: John Murray. 1907. Pp. xxiv. and 210. *Maps and Illustrations*), is a fine study of the place in imperial geography and strategy occupied by such ports as Gibraltar, Aden, Singapore, Hong-Kong, and Vancouver. In the sub-title reference is especially made to the Japanese alliance, and four chapters are devoted to Japan. If imperial geography

were a subject within the view of the public at large, the book would be widely read; it should at least help to make it so. The author writes from personal knowledge gained in a journey which carried him round the world, so that the numerous excellent descriptions are at first hand. The maps are rough, and in most cases add little if anything to the text.

THE MONTHLY RECORD.

EUROPE.

Geography of the Temporary Settlements in the Alps.—The aims and methods of research in regard to these settlements are the subject of an article by Dr. R. Sieger in the *Geographische Zeitschrift* (vol. 30, No. 7). The author points out that temporary settlements are not confined to grazing in the higher Alps. The inhabitants of Eifisch valley, *e.g.*, are called not only up to the heights to tend their cattle, but also down to the Rhone valley to tend their vineyards. Temporary settlements belong mostly, however, to a continuous mountain chain defined not altogether by isohypses nor by climatic limits, but also by economic needs. A pastoral region may be in part left unoccupied because not all needed. Or it may be inadequate, causing a depression or even effacement of the forest region. The need for wood accounts for the maintenance of forest patches alongside the pasture. The problem involves the consideration whether a settlement is occupied by only those actually employed, by whole families, or a whole village; whether a pasturage for sheep, for young or milkless cattle; whether occupied, as in the Italian Alps, by the owner and his family half the year. Account must be taken of the number and kind of settlements and buildings; the *personnel* and cattle; the distance of the lower Alps utilized in spring and autumn from the high Alps, and of both from the homestead; the ways to and fro; the paths up the Alps as important ways of communication in the past; the antiquity of the huts, the form and construction of which are often of interest in the history of domestication. The question of ownership, including not only private and communal, but also "common possession," calls for an adjustment of anomalies, which has stimulated the demand, especially in Austria, for statistical information. Statistics of a comprehensive or connected character exist only for Switzerland. The Tirol, and Carinthia, comprehending a wide variety of categories, and provided with descriptive matter, based more or less on a cadastral survey, much of which is valuable geographically. The paper includes a discussion of methods of geographical inquiry. Resolutions were carried at the Nürnberg *Geographentag*, at which the paper was read on May 23 last, affirming the importance of such investigation, greeting the efforts hitherto made in different parts towards a statistical record, and declaring the desirability of having similar registers drawn up for the whole of the Alpine lands, and of having the original material of these registers published as widely as possible.

ASIA.

Great Britain and Russia in Asia.—The convention signed at St. Petersburg on August 31, 1907, by Sir A. Nicholson and the Russian minister of foreign affairs, M. A. Iswolski, deals with various questions respecting the respective territories and spheres of influence in Asia—questions which have been at issue, either actually or potentially, between the two Powers for a number of years. Most of these are now definitively settled by the recent agreement, and it is to be hoped that it will enable the two nations to pursue their respective paths in the Asiatic continent without fear of mutual friction or complications. In some respects the part of the convention relating to Persia is of the most importance.

The two governments, while pledging themselves to respect the independence of that country, have come to an agreement respecting the portions of its territory which are in future to be reserved, respectively, for the exercise of British and Russian influence. The accompanying sketch-map indicates the lines by which these areas are bounded. Great Britain engages "not to seek for herself and not to

SKETCH-MAP ILLUSTRATING THE CONVENTION BETWEEN GREAT BRITAIN AND RUSSIA IN REGARD TO PERSIA. - - - - BOUNDARIES OF ZONES DEFINED BY THE CONVENTION.

support in favour of British subjects, or of the subjects of third Powers, any concessions of a political or commercial nature—such as concessions for railways, banks, telegraphs, roads, transport, insurance, etc.—beyond a line starting from Kasr-i-Shirin, passing through Isfahan, Yezd, Kakhk, and ending at a point on the Persian frontier at the intersection of the Russian and Afghan frontiers;" and

also pledges herself not to oppose demands for similar concessions supported by the Russian Government. A precisely similar undertaking is given by Russia with regard to the south-east portion of Persia, "beyond a line going from the Afghan frontier [precise point not specified *] by way of Gazik, Birjand, Kerman, and ending at Bunder Abbas." The places mentioned are, in each case, to be included in the area they are used to define. A separate section concerns Afghanistan, and in this Great Britain declares that she has no intention of changing the political status of that country, or of interfering in its internal government, provided that the Amir fulfils the engagements already contracted by him in the treaty of 1905. The Russian Government, on the other hand, recognizes Afghanistan as outside the sphere of Russian influence, and undertakes to conduct all their political relations with that country through the intermediary of the British Government. The last part of the convention has to do with Tibet. Both powers engage to respect the territorial integrity of that country, and to abstain from all interference in its internal administration. They also recognize the Chinese suzerainty over Tibet, and engage not to enter into negotiations with it except through the Chinese Government, nor to send representatives to Lhasa. The provisions of the convention of 1904 relating to commercial intercourse beeween Great Britain and Tibet still, however, hold good; but apart from this, the two countries are placed on a footing of absolute equality. By an exchange of notes between the plenipotentiaries on the date of the convention, the two Powers record their sense of the undesirability of the entry of any scientific mission into the country for a period of three years. It will be seen that in every case the result of the convention is a virtual recognition of the *status quo*.

Dr. Sven Hedin's Expedition.—From a letter written by Dr. Sven Hedin from Mansarowar lake on July 25, 1907, the substance of which is printed in the *Pioneer Mail* of Allahabad for September 20, it is evident that the explorer has accomplished a further piece of excellent geographical work since he was heard of from Shigatse early in the year. Although both the terminal points of his route—Shigatse and Tokchen on the Mansarowar lake—coincided with those of Major Ryder and Captain Rawling on their march up the valley of the upper Sanpo, he was able, by constantly deviating to the right and left, to avoid known ground almost entirely, the "Tasam," or high-road used in the main by the British surveyors, being followed for two and a half days only out of a total of eighty-one and a half days. In this way he increased the distance from 510 to 756 miles. The following is an extract from his letter: "To begin with, I followed the northern bank of the Tsanpo (Brahmaputra), then the Ragha-Tsanpo; left it again, and went to the north-west, my wish being to reach Dangra-yum-tso. So I had once more an opportunity to cross the gigantic mountain range, which is a watershed between the Brahmaputra and the self-contained lakes in the heart of Tibet. I crossed it now by the pass Chang-lung-podla. I camped at the eastern foot of Targuganpi, one of the most magnificent snow-mountains I have ever seen in Tibet, and, like Kailas (or Gang-rimotche), regarded as holy by the Tibetans, and I was within sight of Dangra-yum-tso, when fifty men, cavalry, stopped me, and told me I could go wherever I liked, only not to the holy lake. So I returned to the south-west, to the source of the Ragha-Tsanpo. The map hereabout is nothing like the reality. Nain Singh's Mun-tso is situated, not south, but

* The beginning of the line is omitted from our map (which must be taken as provisional only), as it is not clear whether or no it starts from the same point as that defining the zone reserved for Russian undertakings.

west of Dangra-yum-tso*; but south-south-west of the last there is a very big lake, Shuru-tso. To the south-west of this there is a high snow-range, which is a ramification from the head range. This last I crossed once again, for the third time, by the Angden-la, and then reached Amchok-tso, which I sounded all over. I was not able to cross and measure Shuru-tso, as the ice was just breaking up." Dr. Hedin says that the Ragha-Tsanpo, where it joins the Brahmaputra, is called Dok-chu, and is the largest tributary above Shigatse. From the confluence he went north-west again for five days, and then south to the junction of the Chata Tsanpo with the main stream. On arriving at Saka-dzong, whither he had sent the main caravan direct, he found that his caravan-leader, Mahomed Isa, who had acted in the same capacity for all the most important expeditions to Tibet from that of Carey onwards, had had a stroke of apoplexy, and, to the grief of all, he died that evening. Continuing to diverge constantly from the Tasam, Dr. Hedin reached the sources of the Kub in three great glaciers, whose enormous moraines cover the country all round. The snowy range which feeds them is called Rubi Gangri. Besides his usual meteorological and survey work, the traveller made constant measurements of the size of the rivers, and examined a number of monasteries. He speaks very highly of the work of his predecessors, Major Ryder and Captain Rawling, and of the excellent results of Sir F. Younghusband's mission, as evinced in the kindness and hospitality of the people.

The Volcano of Aso, in Kiu-shiu.—This great volcano, though briefly referred to in gazetteers and guide-books, is not often visited by travellers, so that the vivid description given by Mr. Robert Anderson in the *Popular Science Monthly* (July, 1907), on the basis of a recent visit, is worthy of attention. It is illustrated by a series of photographs which clearly bring out the remarkable features of the volcano and its surroundings. The most striking fact is the vast size of the ancient crater within which the present seat of activity is placed, its precipitous walls enclosing an area of at least 100 square miles, occupied by numerous villages whose inhabitants till the volcanic floor. Mr. Anderson claims for this crater the supremacy of all known volcanic craters in point of size, though curiously enough, the same claim has been made almost simultaneously for one of the old volcanoes of East Africa by the German traveller, Dr. Fritz Jaeger (see below, p. 562). The floor is divided into two crescent-shaped portions by the range of Aso, composed of several distinct summits, the most imposing being Neko-dake, the summit of which forms a jagged battlement of lava pinnacles. The higher summit of Taka-dake rises about 4000 feet above the crater floor. The modern crater, from which steam constantly escapes, lies on a low part of the range, its cone rising from an almost level upland strewn with mounds of volcanic *débris*. Standing at the brink, the traveller looks down walls of roughly stratified mud to a depth of 300 or 400 feet. The crater is oval in shape and divided into five compartments, or vents, only two of which are active. Severe eruptions have occurred within recent times, in 1873–74, 1884, 1889, and 1894. From the regularity of the outer slopes of the walls of the great crater, it seems likely that they represent the truncated base of an old conical mountain, the summit of which has since been removed, either by some cataclysmic explosion, or by sinking of the central mass. Mr. Anderson, who calculates that the volume of the material removed must have been at least 28 cubic miles, or two and a half times that of a mountain like Vesuvius, inclines to the latter as the more probable mode of action. The range which now traverses the crater seems to be a later formation.

Researches in Sumatra.—The German traveller, Dr. Alfred Maass, well known for former scientific work in Sumatra, has lately undertaken a new journey

* It is only fair to the Pundit to state that his Mun Cho lakes were inserted from hearsay only, as they lay at a considerable distance from his route.

into the central portion of that island. Details of his movements have been given from time to time in the *Zeitschrift* of the Berlin Geographical Society. From the seventh issue for the present year we learn that, starting from Taluk, he has reached Gunung Sahilan, a centre of population on the left bank of the Kampar Kiri. The people of this region, who seem to present affinities with the inhabitants of Menang Kabau, made a favourable impression on the traveller, though both they and their country are poor. Herr Maass proposed to return to the coast at the end of July, thus completing a traverse of Central Sumatra from Padang to Siak.

AFRICA.

Journeys in the French Sahara.—The activity with which the French are pushing forward the consolidation of their influence in the Central Sahara receives a fresh illustration from the journey of Captain Arnaud, who, as is announced in the August number of the *Bulletin du Comité de l'Afrique française*, has lately made a journey across the whole of that region from Algeria to the coast of Dahome at Kotonu. During the first part of the route he was accompanied by Lieut. Cortier, while, after traversing the Hoggar region (in part by new routes), a junction was effected with detachments from the Sudan which had also covered some new ground. Subsequently, Lieut. Cortier remained in the "Adrar of the Iforas" for the purpose of completing a map of the whole mountainous region between the Algerian Sahara and the Niger; while Captain Arnaud, accompanied by Captain Pasquier, proceeded to the Niger at Gao, and thence, partly by river, partly overland, continued his journey to the coast. The whole journey occupied 127 days, and of a total itinerary of 3200 miles, 750 were over new ground. The same *Bulletin* reports that a successful reconnaissance into Borku has been made by Captain Bordeaux.

Dr. Jaeger's Journey in East Africa.—Dr. Jaeger and his companion, Herr Oehler, whose scientific researches in German East Africa were referred to in the *Journal* for April last (p. 459), returned to Europe early in the summer after completing a detailed examination of the interesting region between Kilimanjaro and the Victoria Nyanza. Extracts from Dr. Jaeger's letters describing the journey and its results have been printed in the *Mitteilungen aus den Deutschen Schutzgebieten* (1907, Nos. 2 and 3). The routes followed formed a particularly close network over the area lying between lakes Manyara and Eiasi and between the parallels of $2\frac{1}{2}°$ and $4\frac{1}{2}°$ S., the features of which have thus been subjected to a fairly complete investigation. They exhibit considerable variety, as stretches of upland or groups of hills alternate with rift-valleys bounded by steep walls, while a number of old volcanoes and craters offer a special object of study. Dr. Jaeger speaks enthusiastically of the district of Iraku, south-west of Manyara, which had been the scene of disturbances before his visit, but had just been successfully opened up. He was struck with the freshness of the air, the greenness of the cultivated areas, and the abundance of running water—advantages none too common in this part of Africa. He also speaks favourably of the inhabitants, who are a fine race, with little of the negro in their composition. Visits were paid to Lake Eiasi and to the small lake or swamp known as Hohenlohe, which proved to have *fresh* water, and to be much nearer the larger lake than had been supposed. Mount Gurui was also ascended. It is a volcanic cone of lava, breached by a caldera due to explosion on the north-east, as well as by a central caldera mainly the result of erosion, the slopes being also much seamed by ravines. Some difficulty was occasioned by want of water, and it was necessary to proceed to Mwanza on the Victoria lake in order to refit. Work was resumed after the rains had set in, a more northerly part of the country being now visited. Striking east through the southern part of

Ndasekera—a mountain land falling in escarpments to the east, west, and south—the travellers reached Ngorongoro, to which district and the little-known volcanoes which surround it special attention was devoted. It forms in itself a depression which Dr. Jaeger regards as an old crater, over 12 miles across, possibly the largest known anywhere.* The whole region is likened by Dr. Jaeger to the Phlegræan fields on a far vaster scale, the peaks reaching heights of 10,000 to 13,000 feet, while apart from Ngorongoro itself, other craters reach a diameter of 2 or 3 miles. Two of the principal peaks are Deani and Lemagrut (Lerobi and Lmagro of existing maps), which together nearly block the rift-valley of Lake Eiasi. Deani has a height of 10,500 feet, and its huge caldera is perhaps nearly 3 miles across. Both the crater and the outer slopes are in great part clothed with primeval forest—at higher levels with bamboos. Lemagrut consists of a "Somma" and a deeply furrowed central cone, without a crater. Its lava has united with that of Deani to form an upland with an elevation of over 8000 feet. Another interesting volcano is Elaneirobi, whose crater—nearly 5 miles across—has its walls clothed in forest, and a salt lake in its centre. The rainy season interfered considerably with Dr. Jaeger's plane-table work, but data for a fairly complete map were obtained. His companion was forced by fever to leave him, but has since quite recovered.

Expeditions in Central Africa.—We learn from the *Zeitschrift* of the Berlin Geographical Society that the well-known ethnologist, Leo Frobenius, has just started on a new research expedition into Central Africa. He has with him Dr. Hugersoff in the capacity of geodesist and geologist, and Herr Fritz Nansen as artist and photographer. He will proceed through Senegal to the upper Niger and Timbuktu, whence he proposes to make an excursion within the bend of the Niger. The second year's work will, according to the explorer's present plans, be devoted to the region of the lower Niger, Togo, and, if possible, the Kamerun. Geographical and economic, as well as anthropological, researches are contemplated. An expedition for the study and mapping of the Kamerun range was to start in September under the leadership of Prof. Hassert, accompanied by Prof. Thorbecke (*Geogr. Zeits.*, 1907, No. 7), while a scientific expedition to Spanish Guinea is announced in *Petermanns Mitteilungen* as about to start from Lübeck, mainly for the purpose of zoological and ethnological collections. Its leader will be Herr Tessmann, who has already done work of the kind in the south of the Kamerun. The same periodical announces the return to the coast of Don Livio Caetani, a son of the Duke of Sermoneta, who has carried out a journey through the Galla countries of Guraghe and Walamo to Lake Rudolf, returning through Kaffa and Jimma.

Geology and Scenery in South Africa.—The connection between the surface features and geological structure of South Africa was clearly sketched by Dr. G. S. Corstorphine in his presidential address to the Geological Society of South Africa in January last, which has been printed in the *Proceedings* of that body for 1907 (pp. xix.–xxvii.). The speaker began by glancing at some of the general characteristics of the area in question, pointing out that, broadly speaking, the resemblances in the scenery are produced by the prevailing geological uniformity, while the differences are due to the variations in the climate. He then considered in detail the mountain belt, the coastal zone, and the interior plateau. In the mountain belt, consisting of true mountain chains with as much intricacy of structure as the Alps of Central Europe, a marked contrast is noticeable between the typical ranges of Cape Colony and such remnants as still exist in Natal, the valleys in the latter case being not structural valleys, but produced by the cutting out

* See, however, the account of Mount Aso in Kiu-shiu, on p. 560, *ante*. The ancient crater in which this is placed seems quite as large.

of great masses of the strata. The whole belt is essentially composed of quartzites, but whereas in the more arid parts of Cape Colony these produce a stern bare landscape, further east the moister climate renders vegetation abundant. Variation due to climatic differences acting on the same geological formations is again seen in the coastal zone, for while in the north-west the granite and schistose rocks form bare and low undulating hills, in the more humid east and north-east numerous rivers flow seaward in deeply cut valleys. The interior plateau shows a greater diversity, both of scenery and geological constitution. The horizontal sandstones and shales of the Karroo form a true denudation landscape, the flat-topped hills marking the earlier, the pointed ones the later, stages of disintegration. The change of scenery which occurs from about the centre of the Orange River Colony, northward into the Central Transvaal, coincides with the prevalence of softer, more felspathic, sandstones, producing, by their more regular weathering, the unbroken aspect of this region. Where the Karroo formations are pierced by basic igneous intrusions we find low ridges extending for miles across the country. In the Central Transvaal, which has been largely stripped of its covering of Karroo rocks, the characteristic type is that in which low but abrupt escarpments of quartzites, with dip-slopes inclining to the north or south, form one side of a valley carved out of the softer slates or shales. This is exemplified in the Gatsrand, Witwatersrand, and other east-to-west ridges. Further north the undulating landscape is due to the presence at the surface of a large extent of the old granite. Everywhere in South Africa denudation has played a preponderating *rôle*, and its intensity at the present day is largely due to the senseless destruction of the vegetable covering by the annual grass-burnings.

AMERICA.

Topography of Alaska.—The work of the U.S. Geological Survey in Alaska has hitherto been mainly concerned with districts likely to be of economic importance, and the areas mapped were often very irregular in outline. An attempt is now being made to provide a series of topographical maps of more uniform plan, and therefore of greater utility from a practical point of view. They will cover quadrangular areas bounded by parallels and meridians, as in the case of surveys within the United States proper, but in view of the less rigorous character of the work, the unit adopted will be larger, viz. a space of 4° of longitude by 2° of latitude. The first of these maps to be issued is that of the eastern portion of the area between the Yukon and Tanana rivers, and it accompanies a description of the quadrangle by Mr. L. M. Prindle, forming Bulletin No. 295 of the survey. It was within the Yukon-Tanana region, which has a total area of about 40,000 square miles, that discoveries of gold in 1886, 1893, and 1902 led to a rapid development of mining, particularly in the Fairbanks region north of the lower Tanana. The two main rivers form the chief routes of travel, the productive areas being reached from these either by overland trails, by tributaries navigable for small boats, or, in the case of the Fairbanks region, by railway and waggon road. The area is a part of the great dissected plateau-like region which stretches east and west through central Alaska, the most characteristic feature (apart from the lowlands on the two great rivers) being the constant repetition of ridges and valleys of fairly uniform height and depth, with occasional more sharply accentuated elevations, especially on the northern edge of the hill country. The drainage systems are strangely intermingled, and there is no well-defined divide between the waters tributary to the Yukon and Tanana. Benches are prominently developed at various levels along some of the streams, indicating changes of level in the past. The original surface being very uniform, the valleys at corresponding points are

developed to about the same depth and have about the same grade, this being usually low almost to the valley-heads, where the rise to the enclosing ridges is very steep. The temperature has an extremely wide range, and the long warm days of summer soon clothe with green luxuriance much of the deeply frozen surface. The great differentiation of the seasons naturally entails much change in modes of living and transportation methods. Spruce timber of large size occurs in the lower valleys of the largest streams, while small spruce (with birch and poplar) covers the lower ridges, the higher parts being mostly bare. The geology is complex, the rocks being chiefly metamorphic—the oldest, schists of probably pre-Devonian age. Besides gold, coal occurs in several localities.

Control of the Colorado River.—The engineering works undertaken for the purpose of confining the Colorado river within its proper bed at the point where it lately broke through its banks to flow into the Salton sea (*Journal*, vol. 29, p. 461) have at last accomplished their object. In a short communication printed in the July number of the *Popular Science Monthly*, Mr. C. A. Byers recounts the various unsuccessful efforts made to obtain control of the river, as well as the building of the dam which finally proved effectual for the purpose. The last of the previous efforts, which, though not itself successful, aided in the final capture, had resulted in the formation of a dam 35 feet high in places, and 3000 feet in length, of which 600 were of rock and the remainder of earth and gravel. The foundations consisted of a mat of willow and cable, held in place by strong piles. As many as 1100 men, 600 horses and mules, besides steam dredgers, shovels, pile-drivers, etc., were employed at one time. The break that occurred in this dam in December, 1906, was 1100 feet wide, but gigantic efforts were at once made to cope with it, and in the short space of thirteen days 100,000 tons of material were dumped into the gap, much of it brought from over 300 miles away. It was practically completed on February 10, but the work of embankment is still being actively carried on, and there will eventually be 16 miles of levee along the west bank of the river. The cost has already exceeded three and a half million dollars. The conditions in the region overflowed by the river have been studied by Dr. MacDougal on behalf of the Desert Laboratory of the Carnegie Institution. From the *Geographische Zeitschrift* (1907, No. 7), we learn that a good deal of water continues to percolate into the Salton lake, so that it is not likely to dry up immediately. In February last it covered an area of 700 square miles. Cultivation of the areas now left dry has already been begun.

Flora of the Florida Sand Keys.—A thorough botanical examination of the small sandy islets lying to the west of Key West, Florida, was made in 1904 by Mr. O. S. Lancing, junior, under the auspices of the Field Columbian Museum. The results are recorded in a paper by Mr. C. F. Millspaugh, forming Publication 118 of that Museum, issued at Chicago in February, 1907. With one or two unimportant exceptions, the flora of all the keys examined is shown by means of sketch-maps, on which the location and extension of the various species are represented by arbitrary signs, the same sign being always used for the same species. Generally speaking, the vegetation of the keys consists of the usual strand species (mangroves, etc.), found in similar situations throughout the Antillean islands But various special points are brought out by the detailed distribution of the species, which are of interest to the student of the subject of plant dissemination in general. Thus, while the mangroves and avicennias usually occur in close association, on the small Ballast key, they were found disposed at the greatest possible distances apart, and two isolated colonies of *Uniola* and *Euphorbia* were noticed on the same islet, though growing elsewhere in association. A remarkable isolation of individual colonies was elsewhere found to exist, and seemed only explicable on the supposition

of the youth of the area on which they occurred. On the narrow sand-ridge of Man key, the main elements of the flora, seven in number, displayed a remarkable arrangement in clear-cut zones, such as was observed nowhere else in the archipelago. On the other hand, Key C of the Marquesas group, though only ¾ mile in diameter and barely 2 feet above the sea at its highest point, showed a large number of diverse species mixed without definite association character, although the greater part is entirely occupied by a mangrove colony. The number of species occurring in so small a space is attributed to the probable resort of aquatic birds. Mr. Millspaugh points out that this careful survey, besides permitting any future changes in the flora to be traced, will be of value as throwing light on the species which come first to such microcosms, thus pointing to the ease or difficulty of dispersion exhibited by certain species; and also on the manner in which species spread when brought into an untainted environment.

AUSTRALASIA AND PACIFIC ISLANDS.

Journey across Western Australia.—After remaining at Flora valley, in the Kimberley division of Western Australia, through the wet season from October to February last, Mr. A. W. Canning, of whose expedition across the desert country between the East Murchison and Kimberley goldfields an account appeared in the June *Journal* (vol. 29, p. 678), started on the return journey and arrived back at Wiluna at the beginning of July, thirteen months after his departure from that place. The journey south confirmed the favourable impression Mr. Canning had derived from the northward march as to the practicability of establishing a stock-route between the pasture lands of the Kimberley division and the markets of the eastern goldfields. The tropical rains were found to have reached about halfway across the desert, and in the neighbourhood of Godfrey's Tank the country presented a remarkably fresh, green appearance. There is some poor country round Separation Well, but this is avoided by the route which Mr. Canning has marked out. Kangaroos and emus were scarce in the country traversed, but the expedition came across numbers of what Mr. Canning describes as "miniature dogs no larger than rats," which are killed by the natives for food. On the whole the natives were again friendly and willing to point out water-holes, though one of the members of the party was speared. From the observations of the expedition, it appears that kindred tribes of aborigines extend latitudinally rather than longitudinally, the dialects changing more rapidly from north to south than from east to west.

POLAR REGIONS.

Dr. Bruce's Expedition to Spitsbergen.—Particulars are now available of the work accomplished during the past summer in Prince Charles Foreland by the Scottish expedition under Dr. W. S. Bruce, brief allusion to which was made in the October number of the *Journal*. Last year a similar expedition under Dr. Bruce, acting in conjunction with the Prince of Monaco, landed on the north-eastern shores of Prince Charles Foreland, and surveyed a considerable portion of the island. In continuation of this work a base camp was established last June on the south-west coast, and several weeks were spent in a survey of the neighbouring country. Brief excursions were also undertaken farther afield, including a cruise up Ice fjord, the great indent in the western shores of the main island of the Spitsbergen group. Early in August Dr. Bruce and two other members of the expedition proceeded northwards, and it was during their absence that Captain Isachsen, acting on behalf of the Prince of Monaco, arrived at the base camp. It was arranged by messenger with Dr. Bruce that the latter should round the northern end of the Foreland and return south along the east coast, where Captain Isachsen was to be

ready to take the explorers on board. The weather conditions, however, prevented the execution of this programme. Unable to round the northern end of the island, Dr. Bruce had to return by the west coast; hence his failure to arrive when expected on the east coast, and hence the fears that were excited as to the safety of the explorers. Throughout the expedition the weather was of an exceptionally trying character; but Dr. Bruce denies that he and his companions were ever in any danger, and repudiates all reports of sensational experiences. As a result of the two years' work in the Foreland, a detailed chart has been obtained of the whole of the west coast on a scale of 2 inches to the mile; the mountainous interior has been similarly surveyed, as well as a considerable portion of the east coast. Specimens of rocks and fossils, some of the latter of which appear to date back before the Tertiary age, promise to throw interesting light on the geological history and formation of the island; and extensive collections of plants and birds have been formed, including several species not previously known to exist in the Spitsbergen group. Dr. Bruce describes Prince Charles Foreland, which has an average length of 55 miles and an average breadth of about 6 miles, as divided into three regions. Hilly country extends for 5 or 6 miles from the southern extremity; for another 14 miles extends low-lying country, nowhere more than 60 feet above sea-level; while the northern two-thirds of the island comprise an almost continuous range of mountains, the highest peaks of which rise to heights of nearly 4000 feet. The Foreland was crossed by the expedition in several places. The mountains are much glaciated, some of the glaciers on the east coast (but not on the west) descending to sea-level. An extensive series of terraced beaches was found to exist between the foot of the mountains and the sea. Dr. Bruce reports that Captain Johansen, Dr. Nansen's companion on the journey from the *Fram* across the North Polar basin, is spending the winter in the north-west of Spitsbergen.

The Duke of Orleans' Expedition to Novaya Zemlya and the Kara Sea.—The success met with by the Duke of Orleans in his expedition to East Greenland in 1905 encouraged him to undertake a new voyage to the polar seas during the past summer. This time the region around Novaya Zemlya was chosen as the field for research, the *Belgica* being again in command of Captain de Gerlache, while several scientific men, including Dr. Recamier, who took part in the former voyage, sailed in the ship, which left Vardo on July 9. The expedition returned to Hammerfest on September 15, the duke arriving in England on September 30, accompanied by Dr. Recamier. A short account communicated to the press states that the *Belgica* passed through Matochkin Shar on July 14, but was soon afterwards beset by heavy ice, from which she was not liberated till August 21. During this time the ship was drifted from the Kara into the Barents sea by north-east winds. The party explored the west coast of Novaya Zemlya, but work was somewhat hampered through the ship grounding on an unknown shoal, which rendered it necessary to lighten her by throwing part of the coal overboard. Nevertheless, the coast of Novaya Zemlya was followed up to 78° N. Valuable scientific observations are said to have been secured. The duke has consented to give the Society an account of the voyage during the approaching session.

The Danish Scientific Station in Greenland.—We learn from the *Geogr. Zeitschrift*, 1907, No. 6, that a first report has been received from the director of this station (*Journal*, vol. 27, p. 408), Mr. M. P. Porsild. The site chosen for the station was Angakudsarrik, in Österdalen, east of Godhavn, a spot well sheltered from the north winds. Winter set in with heavy snowfalls in September, but the work at the station was not thereby interrupted. The library of over 3000 volumes was opened at Christmas, and the laboratory was ready for use by February. The winter was unusually severe even for this high latitude, the snowfall being

exceedingly heavy, while a temperature of 27° below zero Fahrenheit was registered. The work on the station proved a godsend to the people of Godhavn, for whom no relief measures were necessary during the winter.

The Area of Greenland has been calculated by Mr. H. Prytz, who gives the result in the latest issue of the *Meddelelser om Grønland* (No. 33). It comes out as 2,143,200 square kilometres, which is equivalent to 826,500 square miles. The areas of different sections of the country are also given, that of the ice-sheet being placed at 1,848,400 square kilometres, or 712,750 square miles, while the settled districts of the west coast amount to only 116,000 square kilometres, or 43,130 square miles.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Deficiency of Mass under Mountain Ranges.—That such a deficiency exists has been shown in the case of various ranges by the results of pendulum observations. It has been supposed by some that this is due to the presence in the Earth's crust, beneath the ranges, of rocks of unusually low specific gravity. This can hardly be considered a probable solution of the problem, and it seems preferable to suppose, according to a suggestion first put forward, apparently, by Prof. Heim, that the cause is to be found in the greater depth to which the ordinary components of the surface layers—rocks with an average specific gravity of about 2·5—reach in localities where such a deficiency of mass has been observed. The same explanation is supported by Herr K. Gugler in a paper, written without knowledge of Prof. Heim's suggestion, and lately printed in the *Vierteljahrsschrift des Naturforschenden Gesellschaft* (vol. 51, 1906, pt. 2–3) at Zürich. This writer supposes that the surface crust, with a specific gravity of 2·5, is replaced at a comparatively small depth by heavier materials, such as iron ores and basic eruptive rocks with a specific gravity of about 5 (the central core being composed of still heavier materials, such as metallic iron). In order to obtain a quantitative test of the theory, he supposes definite lines of division (at arbitrarily chosen depths) between the various layers, though recognizing that a progressive increase with the depth is more probable, and shows that the required "isostasy" is obtained by supposing either of the two upper layers to reach a greater thickness beneath mountain ranges than elsewhere. This would be quite consistent with the supposition that mountain formation is due to tangential thrust in the outer layers, due to shrinking of the core, for with diminution of area the crust must become correspondingly thicker, and the ridging up of portions would involve a sinking of the under surface of the crust in order to preserve equilibrium. The writer's supposition as to the relative specific gravities of the outer and inner layers of the crust (2·5 and 5) leads him to the result that the basal depression of the lighter of the two under a mountain range is the exact equivalent of the elevation of the range; but this would, of course, not hold good in any other case.

Icebergs near the Orkneys in 1836.—Dr. L. Mecking lately called attention to a statement of Dove, in an article on north polar currents published in 1854, that two large icebergs were sighted in 1836 by Sir James Ross, in the ship *Cove*, not far from the Orkney islands. He pointed out (*Zeitschrift Ges. Erdk. Berlin*, 1907, No. 3) that in the published accounts of the voyage (which was undertaken for the purpose of carrying assistance to a whaling-fleet in Baffin bay) no mention is made of such an occurrence, while negative evidence seemed also supplied by the general consensus of opinion on the part of writers on hydrography, that no icebergs had ever been seen on or near the British coasts. On the other hand, a letter from one of the officers of the *Cove*, printed in the *Nautical Magazine* for 1836, contained the statement, "We have been in company with icebergs," but with no indication of place or date. Dr. Mecking concluded that unless some more substantial evidence

was forthcoming, we must suspend judgment on the correctness of Dove's statement. The required evidence has since been obtained, for during a recent visit to this country, Prof. Krümmel, who had till then been sceptical as to the truth of the story, suggested to Captain C. Hepworth the examination of the original log of the voyage. The result, which Prof. Krümmel notes in the seventh number of the *Zeitschrift*, p. 473, is to fully confirm the statement, the log for the morning of January 14, 1836, recording the observation of two icebergs (size not mentioned) in 60° 55′ N., 5° 50′ W. The position is 40 nautical miles south-east of Suderö in the Færoes, and 130 miles north-west of the Orkneys, at the north-west corner of the Færoe-Shetland channel, with a depth of about 160 fathoms. The bergs, as Prof. Krümmel points out, must undoubtedly have been derived from the polar current which runs east of Iceland.

GENERAL.

The Centenary of the Geological Society was celebrated in London on September 26 and following days. On the morning of that day the president, Sir A. Geikie, received the delegates from foreign countries, scientific societies, and other bodies throughout the world, in the hall of the Institution of Civil Engineers. The Society was represented by Major C. F. Close, who presented an address of congratulation on behalf of the Council. In the afternoon of the same day Sir Archibald Geikie (to whom the medal of the Institution of Mining and Metallurgy had been presented in the morning by the representatives of that body) delivered an address of welcome to the delegates and other guests, and spoke of the progress made by geological science during the past century, and of the part taken in its development by the Geological Society. A dinner was held in the evening at the Hôtel Métropole.

International Seismological Association.—The first International Earthquake Conference held since the complete organization of this association took place at The Hague from September 21 to 25, under the presidency of Prof. L. Palazzo, Director of the Italian Meteorological Office. It may be remembered that the first conference of the kind was held at Strassburg in 1901, and that it led to the decision to work for the establishment of an association of states to be officially represented at future conferences. A first meeting of such official representatives was held at Strassburg in 1903, and led to the organization of the association on definite lines by the acceptance of a series of regulations, a full reprint of which will be found in *Petermanns Mitteilungen* for 1903 (p. 201). The central bureau of the association has since been inaugurated at Strassburg (*Journal*, vol. **28**, p. 81). The work of the recent conference had to do partly with the general administration of the association, and partly with the discussion of practical questions relating to its scientific work, which include the collection and correlation on a uniform system of earthquake observations made at various stations throughout the world, the preparation of a bibliography, the issue of an annual catalogue of earthquakes, and so forth. Among the minor points discussed were the establishment of a station at Kashgar, and the problem offered by the somewhat mysterious sound phenomena known as Barisal guns, Mistpoeffers, and by other names.

Were Dapper and Montanus one Individual?—That such was the case is laid down by Mr. R. R. Schuller in a pamphlet printed (without date) at Santiago in Chile. The original Dutch edition of the 'New and Unknown World,' printed at Amsterdam in 1671, appeared under the name of Arnold Montanus, while the German translation of 1673 was ascribed on the title to Dr. O. D., evidently Dapper. This has somewhat puzzled the bibliographers, including the acute and learned P. A.

Tiele ('Nederlandsche Bibliographie van Land- en Volkenkunde,' s.v. *Montanus*), who suggests that the two men formed a literary co-partnership. Mr. Schuller points to the privilege of the 1673 edition, in which the original Dutch work is definitely ascribed to Dapper, as proving his contention, and criticizes the bibliographers for not discovering the identity of the two authors. He states that no biography of Montanus is to be found, while notices of Dapper appear in all the great biographical dictionaries. The notice of Dapper by Eyriès, in the 'Biographie Universelle' (Michaud's) speaks, however, of Montanus as a distinct individual, and we are informed that a special notice of him appears in Van der Aa's 'Biographisch Wordenboek der Nederlanden.' The suggestion, therefore, cannot certainly be accepted.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full :—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendes.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

France—Meurthe-et-Moselle. *C.R.A. Sc. Paris* **144** (1907): 586–589. **Nicklès and Joly.**
Sur la tectonique du nord de Meurthe-et-Moselle. Note de René Nicklès et Henry Joly. *With Sketch-map.*

Germany—Baltic Coast. *Annalen Hydrographie* **35** (1907): 113–122, 149–163. **Kaiser.**
Land- und Seewinde an der deutschen Ostseeküste. Von Max Kaiser. *With Charts and Diagrams.*

Germany—Bavaria. *Deutsche G. Blätter* **30** (1907): 24–30. **Breu.**
Neue Gewitterstudien an Oberbayrischen Seen. Von Georg Breu. *With Sketch-map.*
Discusses the cause of the frequency of storms in this region.

Germany—Bavaria. *Deutsche Rundschau f. G.* **29** (1906–7): 241–246. **Breu.**
Haben die Oberbayrischen Seen einen Einfluss auf die Gewitterbildung und auf den Gewitterverlauf? Von Georg Breu. *With Sketch-map and Diagram.*

Germany—Ice Age. **Thienemann.**
X. Jahresber. G. Ges. Greifswald, 1905–6 (1907): 381–462.

Planaria Alpina auf Rügen und die Eiszeit. Von Dr. August Thienemann. *With Maps and Plate.*

Germany—Morphology. **Spethmann.**

Die Lübecker Mulde und ihre Terrassen. Ein Beitrag zur postglazialen Genetik des südwestlichen Ostseebeckens. Von Hans Spethmann. (Separat-Abdruck aus dem Centralblatt für Mineralogie, etc., 1907, No. 4.) Size 9 × 6, pp. 97–105.

Germany—Phytogeography. *Petermanns M.* **53** (1907): 25–36. **Höck.**

Versuch einer pflanzengeographischen Umgrenzung und Einteilung Norddeutschlands. Von Prof. Dr. F. Höck. *With Map.*

Germany—Pomerania. **Bellmer.**
X. Jahresber. G. Ges. Greifswald, 1905–6 (1907): 463–502.

Untersuchungen an Seen und Söllen Neuvorpommerns und Rügens. Von A. Bellmer. *With Maps and Sections.*

"Söllen" are small roundish depressions, filled either with water or peaty substances.

Germany—Pomerania. **Deecke.**
X. Jahresber. G. Ges. Greifswald, 1905–6 (1907): 43–60.

Vineta. Von W. Deecke. *With Sketch-map and Illustrations.*

The writer believes that the tradition of the sunken city of Vineta points to a sinking of the coast-line in the early middle ages, by which a group of dolmens or other burial-monuments was covered by the sea.

Germany—Posen. *X. Jahresber. G. Ges. Greifswald*, 1905–6 (1907): 351–380. **Lehmann.**

Wanderungen und Studien in Deutschlands grösstem binnenländischen Dünengebiet. Von F. W. Paul Lehmann. *With Sketch-maps and Diagrams.*

Germany—Prussia. *X. Jahresber. G. Ges. Greifswald*, 1905–6 (1907): 1–27. **Elbert.**

Die Landverluste an den Küsten Rügens und Hiddensees, ihre Ursachen und ihre Verhinderung. Von Dr. Joh. Elbert. *With Map.*

Germany—Prussia. *X. Jahresber. G. Ges. Greifswald*, 1905–6 (1907): 61–221. **Elbert.**

Die Entwickelung des Bodenreliefs von Vorpommern und Rugen, sowie den angrenzenden Gebieten der Uckermark und Mecklenbergs während der letzten diluvialen Vereisung. Von Dr. Johannes Elbert. Zweiter Teil. *With Map and Sections.*

Germany—Prussia. *Deutsche Erde* **6** (1907): 2–6. **Hahn.**

Die Entstehung der Bevölkerung Ostpreussens. Begleitworte zur Nationalitätenkarte von Ostpreussens. Von Prof. Dr. Friedrich Hahn. *With Map and Illustrations.*

Holland—Geology. *Ts. K. Nederland. Aardrijksk. Genoots.* **24** (1907): 129–166. **Baren.**

De morphologische bouw van het diluvium ten westen van den Ijsel. Door J. van Baren. *With Map and Illustrations.*

Italy—Capri. **Furchheim.**

Die Blaue Grotte auf Capri. Eine Monographie von F. Furchheim. Wien, 1907. Size 9½ × 6½, pp. 12. *Illustrations.*

Italy—Capri. **Trower.**

The book of Capri. By Harold E. Trower. Naples: Emil Prass, 1906. Size 8½ × 5½, pp. xxviii. and 346. *Illustrations. Price* 5 *lire. Presented by the Author.*

An excellent handbook for visitors to the island.

Italy—Como. *Riv. G. Italiana* **14** (1907): 79–89. **Bianchi.**

Sulla distribuzione della popolazione nella provincia di Como. Studio del Dott. Franco Bianchi.

Italy—Historical. *Rendiconti R.A. Lincei* **15** (1906): 199–225. **Pais.**

Intorno all'estensione del nome degli Ausones e dell' Ausonia. Di Ettore Pais.

Italy—Sicily. *Riv. G. Italiana* **14** (1907): 1–15. **Almagia.**

Distribuzione della popolazione in Sicilia, secondo la constituzione geologica del suolo. Studio dell dott. Roberto Almagià.

Italy—Venetia. *Mem. G., Riv. G. Italiana* **1** (1907): 1–100. **Marinelli.**

Studi sopra i limiti altimetrici. I. I limiti altimetrici in Comelico. Ricerche di Olinte Marinelli. *With Maps and Illustrations.*

This forms the first part of a series of memoirs supplementing the *Rivista Geogr. Italiana.*

Norway. *G. Teacher* **4** (1907): 5–15. **Brigham.**

The Fiords of Norway. A study in human geography. By Prof. Albert Perry Brigham.

Pyrenees. **Briet.**

Les Pyrénées et la spéléologie. Par Lucien Briet. (Extrait du Bulletin Pyrénéen, No. 61. Janvier-Fevrier, 1907.) Size 9 × 6, pp. 10.

Pyrenees. **Stuart-Menteath.**

Pyrenean Geology. By P. W. Stuart-Menteath. Parts 6 and 7–8. London: Dulau & Co., 1906–7. Size 8½ × 5½, pp. (part 6) 38; (parts 7–8) 28. *Presented by the Author.*

Russia—Cartography. *M.G. Ges. Hamburg* **21** (1906): 1–61. **Michow.**

Das erste Jahrhundert russischer Kartographie 1525–1631 und die Originalkarte des Anton Wied von 1542. Von H. Michow. *With Facsimile Maps.*

Scandinavia—Glaciation. *Z. Ges. E. Berlin* (1907): 27–43, 87–101. **Werth.**

Studien zur glazialen Bodengestaltung in der skandinavischen Ländern. Von Dr. Emil Werth. *With Sketch-maps.*

Spain. **Rikli.**

Kultur- und Naturbilder von der spanischen Riviera. Von Dr. M. Rikli. (Neujahrsblatt der Naturforschenden Gesellschaft in Zürich auf das Jahr 1907; 109 Stück.) Zurich, 1907. Size 11 × 9, pp. 46. *Illustrations.*

Switzerland—Alps. **Heim.**

Vierteljahrschrift Naturfors. Ges. Zürich **51** (1906): 462–472.

Die Erscheinungen der Längszerreissung und Abquetschung am nordschweizerischen Alpenrand. Von Arnold Heim.

Switzerland—Historical. *Globus* **91** (1907): 159–160. **Mehlis.**

Das romische Grenzwehrsystem in der Nordschweiz. Von Dr. C. Mehlis. *With Sketch-map.*

United Kingdom—Cornwall. **Hill and MacAlister.**

Memoirs of the Geological Survey. England and Wales. Explanation of sheet 352. The Geology of Falmouth and Truro and of the mining district of Camborne and Redruth. By J. B. Hill and D. A. MacAlister. London, 1906. Size 10 × 6, pp. x. and 336. *Sketch-map and Illustrations.*

United Kingdom—Cornwall. **Reid and Scrivenor.**

Memoirs of the Geological Survey: England and Wales. The geology of the country near Newquay. By Clement Reid and J. B. Scrivenor. London, 1906. Size 9½ × 6, pp. iv. and 132. *Illustrations and Sketch-map.*

United Kingdom—England. *G. Teacher* **4** (1907): 29–38. **MacMunn.**

The economic historical geography of a county, illustrated from Essex and Cumberland. By Nora E. MacMunn.

United Kingdom—England—Coal. *J.S. Arts* **55** (1907): 450–460. **Dawkins.**

The discovery of the south-eastern coalfield. By Prof. W. Boyd Dawkins. *With Map and Section.*

United Kingdom—Ireland. *P.R. Irish A.* **26** (1907): B., 74–96. **Kilroe.**

The river Shannon: its present course and geological history. By J. R. Kilroe. *With Map and Sections.* (See p. 208, *ante*.)

United Kingdom—Ireland. **Lamplugh and others.**

Memoirs of the Geological Survey of Ireland. The geology of the country around Limerick. By G. W. Lamplugh and others. Dublin, 1907. Size 9½ × 6, pp. vi. and 120. *Maps and Illustrations.*

United Kingdom—London. *London Topographical Record* **4** (1907): 113–140. **Gomme.**

Catalogue of the exhibition of maps, views, and plans of London, exhibited at the conversazione held at Drapers' Hall on Thursday, March 16, 1905. By Bernard Gomme.

United Kingdom—London. *London Topographical Record* **4** (1907): 1–12. **Norman.**

Address by Philip Norman [on the Roman Wall of London]. *Plan and Illustrations.*

United Kingdom—Scotland. *Scottish G. Mag.* **23** (1907): 192–202. **Hinxman.**

The rivers of Scotland: the Beauly and Conon. By Lionel W. Hinxman. *With Map and Sections.*

United Kingdom—Somerset. **Moss.**

Geographical Distribution of Vegetation in Somerset: Bath and Bridgewater district. By C. E. Moss. London: R.G.S., 1907. Size 9½ × 6, pp. 72. *Maps and Illustrations.*

Forms one of the same series as the monographs of Dr. W. G. Smith, Mr. Lewis, and others, which have appeared in the *Journal*. The present paper is issued as an Extra Publication.

ASIA.

Philippines—Ethnology. *Philippine J. Sc.* **1** (1906): 791–876. **Worcester.**

The non-Christian Tribes of Northern Luzon. By Dean C. Worcester. *With Plates. Also separate copy, presented by the Author.*

There are 67 plates illustrating the physical characters and mode of life of these tribes.

Philippines—Geology. *Philippine J. Sc.* **1** (1906): 617–636. **Smith.**

Preliminary geological reconnaissance of the Loboo mountains, Batangas province. By W. D. Smith. *With Map, Section, and Illustrations.*

Philippines—Phytogeography. *Philippine J. Sc.* **1** (1906): 373–431, 637–682. **Whitford.**

The Vegetation of the Lamao Forest Reserve. By H. N. Whitford. *With Map and Illustrations.*

Discusses the plant-formations, which are illustrated by numerous excellent photographs.

Russia—Caucasus. *M.G. Ges. Hamburg* **21** (1906): 177–201. **Albrecht.**

Durch den Daghestan auf der Awaro- Kachetinischen Strasse im Mai-Juni 1904. Von Dr. Max Albrecht. *With Illustrations.*

Siam—Fauna. **Mortensen and With.**

Mém. A.R. Sc. Danemark, VII. Ser., **1** (1904): 1–124; **3** (1906): 1–214.

The Danish Expedition to Siam, 1899–1900. II. Echinoidea (1) by Dr. Th. Mortensen; and III. Chelonethi: an account of the Indian False Scorpions, together with Studies on the Anatomy and Classification of the Order. By C. J. With. *With Map and Plates.*

Siam—Treaty. *B. Comité Asie française* **7** (1907): 83–86. **Caix.**

Le nouveau traité franco-siamois. Par Robert de Caix.

See note in the May number (p. 569).

Turkey—Asia Minor. *Contemporary Rev.* **90** (1906): 786–800. **Ramsay.**

The Peasant-God: the Destruction and the Restoration of Agriculture in Asia Minor. By Sir W. M. Ramsay.

Turkey—Asia Minor. *B.S.G. Italiana* **IV. 8** (1907): 201–229. **Vannutelli.**

Nella Turchia Asiatica. Del cav. Lamberto Vannutelli. *With Illustrations.*

AFRICA.

French West Africa. *Deutsche G. Blätter* **30** (1907): 1–23. **Beyer.**

Französisch-Westafrika. Eine Kolonialwirtschaftliche Studie. Von Prof. Dr. A. Beyer.

French West Africa. ———

Trade and Agriculture of French West Africa for the year 1905–6. (Foreign Office Annual, No. 3763, 1907.) Size 9½ × 6, pp. 30. *Price 2d.*

German East Africa. *M. deuts. Schutzgebieten* **19** (1906): 336–338. **Moisel.**

Begleitworte zu der "Karte des südlichen Teiles der Nguru-Berge." Von M. Moisel. *With Map.*

Gold Coast. *B.S. Neuchateloise G.* **17** (1906): 7–312. **Perregaux.**

Chez les Achanti. Par Edmond Perregaux. *With Illustrations.*

Kamerun—Boundary. *Petermanns M.* **53** (1907): 36–39. **Hermann.**

Die Nordwestgrenze von Kamerun. Ein Typus moderner Grenzentwickelung. Von Dr. R. Hermann. *With Maps.*

The maps show successive stages in the evolution of the boundary.

Madagascar—Ethnology. *Rev. de Madagascar* **8** (1906): 1025–1054. **Jully.**

Ethnographie de Madagascar. Par A. Jully.

Morocco. *B. Comité Afrique française* **16** (1906): 307–314. **Dyé.**

La mission hydrographique du Lieutenant de Vaisseau Dyé au Maroc (Campagne de 1906). Rapport sommaire No. 3; par le Comm. A.-Henri Dyé. *With Illustrations and Supplement.*

Morocco—Atlas. *Ann. G.* **16** (1907): 70–77. **Gentil.**

Notice sur l'esquisse géologique du haut Atlas occidental (Maroc). Par Louis Gentil. *With Map.*

North Africa—Atlas. *Jahresber. Frankfurter V.G.* **70** (1905–6): 5–87. **Knoch.**

Die Niederschlagsverhältnisse der Atlasländer. Von Dr. Karl Knoch. *With Map.*

Rhodesia. **Gregory.**

The Mining Fields of Southern Rhodesia in 1905. By J. W. Gregory. (From the *Transactions of the Institution of Mining Engineers.*) London, etc., 1906. Size 9½ × 6, pp. 60. *Sketch-map, Illustrations, and Diagrams.*

Rhodesia. *Mem. Manchester Philosoph. S.* **51** (1906–7): No. 3 (pp. 7). **Neave.**

A Journey to North-East Rhodesia during 1904 and 1905. By S. Neave. *With Sketch-map.*

The writer went out in 1904 as naturalist to the Geodetic Survey in North-East Rhodesia. The same journal contains reports on his collections.

Rhodesia—Barotseland. *B.S. Neuchateloise G.* **17** (1906): 313–323. **Burnier.**

De Seshéké à Lealouyi par une route nouvelle. Par F. Burnier. *Sketch-map.*

The route lay east of the Zambezi, between the latter and the regular waggon road.

Rhodesia—Zimbabwe. **Hall.**

Visitors' Guide to the Great Zimbabwe Ruins: Mashonaland, Rhodesia, South Africa. By R. N. Hall. [Cape Town], 1907. Size 8½ × 5½, pp. 34. *Plans and Illustrations. Price* 1*s.* 6*d.*

Rhodesia—Zimbabye. *Globus* **91** (1907): 229–232. **Passarge.**

Ophir und die Simbabyekultur. Von Dr. L. Passarge.

The writer believes that traces of Asiatic culture are to be seen at Zimbabye, but that it has suffered deterioration through the African medium which has transmitted it.

Sahara. *Z. Ges. E. Berlin*, 1907: 166–172. **Passarge.**

Geomorphologische Probleme aus der Sahara. Von Prof. Dr. S. Passarge.

Sahara—French. *La G., B.S.G. Paris* **15** (1907): 1–28, 103–120. **Gautier**

A travers le Sahara français. Par E.-F. Gautier. *With Map and Plan.*

Sahara—French. *B. Comité Afrique française* **17** (1907): 80–83. **Terrier.**

La frontière terrestre de l'Afrique occidentale et centrale. Par Auguste Terrier. *With Map.*

Discusses the political position in the region north-east of Lake Chad, with an account of Captain Mangin's explorations. (Cf. note in vol. **29**, p. 569.)

Sahara—French. **Touchard.**

Renseignements Col., Comité Afrique française **16** (1906): 301–317, 359–364, 371–396.

Travaux et reconnaissances de pénétration saharienne, exécuté dans le sud Contantinois par le cercle de Touggourt. Rapport du Capitaine Touchard. *With Maps and Illustrations.*

Sahara—French. **Vallier.**

Renseignments Col., Comité Afrique française **16** (1906): 269–285, 325–332, 338–358, 396–403.

Explorations dans le Ferlo, 1904–1905. Par le Capitaine Vallier. *With Maps and Diagrams.*

South Africa. **Penck.**

Süd-Afrika und Sambesifälle. Von Albrecht Penck. (Gesellschaft deutscher Naturforscher und Ärzte; Verhandlungen, 1906. Sonderabdruck.) Leipzig, 1906. Size 9½ × 7, pp. 16. *Presented by the Author.*

Cf. note in vol. **27**, p. 630.

Sudan—River-systems. **Audoin and Adhémar.**

Renseignements Col., Comité Afrique française **16** (1906): 365–371.

Étude des relations par eau du Logone avec la Bénoué. Par MM. Audoin et d'Adhémar. *With Maps.*

See note in the May number, p. 570.

West Africa—Boundary. ——

Treaty Series, No. 8, 1907. Agreement between the United Kingdom and France relative to the Boundary between the Gold Coast and the French Soudan, July 19, 1906. London, 1907. Size 9½ × 6, pp. 24. *Maps.* *Price* 2*s.* 1½*d.*

West Africa—Ethnology. *B.G. Hist. et Descriptive* (1906): 82–119. **Maclaud.**

Étude sur la distribution géographique des races sur la côte occidentale d'Afrique, de la Gambie à la Mellacorée. Par le Dr. Maclaud. *With Map.*

West Africa—Pilot. ——

Africa Pilot, Part i.; or Sailing Directions for the West Coast of Africa, from Cape Spartel to the river Cameroon, also the Azores, Madeira, Canary, and Cape Verde Islands. 7th Edition, 1907. London, 1907. Size 9½ × 6, pp. xxiv. and 640. *Index-map.* *Price* 3*s.*

NORTH AMERICA.

Newfoundland. [MacGregor.]

Report on the foreign trade and commerce of Newfoundland, 1905–06. Size 13 × 8½, pp. vi., vi., 46, and 30. *Diagrams.*

Noticed in the Monthly Record (July, p. 91).

United States—Areas. *B.U.S. Geol. Surv.* 302 (1906): pp. 10. **Gannett.**

The areas of the United States, the states, and the territories. By Henry Gannett. *With Map.*

See note in the Monthly Record for June (p. 676).

United States—California. *Sierra Club B.* 6 (1907): 115–127. **Colby and others.**

Report on the King's River Cañon and vicinity. By Wm. E. Colby, J. N. Le Conte, and E. T. Parsons. *With Illustrations.*

United States—California. **Omori.**

B. Imp. Earthquake Investigation Com. 1 (1907): 7–25.

Preliminary note on the cause of the San Francisco earthquake of April 18, 1906. By Dr. F. Omori. *With Maps, Diagrams, and Illustrations.*

United States—Coal. *National G. Mag.* 18 (1907): 129–138. **Campbell.**

How long will the coal reserves of the United States last? By Marius R. Campbell. *With Diagrams.*

United States—Colorado. *U.S. Geol. Surv., Prof. Paper* 52 (1906): pp. 90. **Darton.**

Geology and underground waters of the Arkansas valley in Eastern Colorado. By N. H. Darton. *With Maps, Plates, and Sections.*

United States—Colorado. **Lindgren and Ransome.**

U.S. Geol. Surv., Prof. Paper 54 (1906): pp. xx. and 516.

Geology and gold deposits of the Cripple Creek district, Colorado. By Waldemar Lindgren and Frederick Leslie Ransome. *With Maps, Diagrams, and Illustrations.*

United States—Connecticut. **Rice and Others.**

Manual of the geology of Connecticut. By Dr. William North Rice and Dr. Herbert Ernest Gregory. Preliminary geological map of Connecticut. By Dr. Herbert Ernest Gregory and Dr. Henry Hollister Robinson. (State of Connecticut: State Geological and Natural History Survey, Bulletins Nos. 6 and 7.) Hartford, 1906–07. Size 9 × 6, pp. (No. 6) 274, (No. 7) 40. *Maps and Illustrations.*

United States—Geological Survey. ——

Twenty-seventh annual report of the director of the U.S. Geological Survey to the Secretary of the Interior, 1905–06. Washington, 1906. Size 9 × 6, pp. 104. *Maps.*

The map of the area covered by typographical surveys shows that there are enormous tracts of country still untouched.

United States—Georgia. *Science* 25 (1907): 428–432. **Johnson.**

River capture in the Tallulah district, Georgia. By D. W. Johnson.

United States—Irrigation. *J. Franklin I.* 163 (1907): 217–242. **Carter.**

Irrigation and the Government irrigation project at Yuma. By Prof. Oscar C. Carter. *With Map and Illustrations.*

The Yuma project is that for irrigating the lands on both sides of the lower Colorado river.

United States—Louisiana and Arkansas. **Veatch.**
U.S. Geol. Surv., Prof. Paper 46 (1906): pp. 422.

Geology and underground water resources of northern Louisiana and southern Arkansas. By A. C. Veatch. *With Maps and Plates.*

United States—Minerals. **Day and Richards.**

Black sands of the Pacific slope in 1905. By David T. Day and R. H. Richards. Washington, 1907. Size 9 × 6, pp. 84. *Presented by the U.S. Geological Survey.*

Report of an investigation regarding the useful minerals (especially platinum) occurring in the "black sands."

United States—Place-names. *B. American G.S.* **39** (1907): 103–106. ——

Names of topographic features in the United States.

Gives the results arrived at by the United States Geographic Board, after correspondence with American geographers and geologists. The name "Cordilleras" is adopted for the entire western mountain system.

United States—South Carolina. *Geological Mag.* **4** (1907): 197–202. **Hobbs.**

The Charleston earthquake of August 31, 1886, in a new light. By William Herbert Hobbs. *With Sketch-map.*

The distribution of the areas of "Craterlets," together with that of points of maximum disturbance on the railway lines, is held to point to two series of parallel fracture-planes within the rocky basement of the region.

United States—Virginia. *B. American G.S.* **39** (1907): 92–102. **Surface.**

Climate and boundaries of Virginia. By G. T. Surface.

United States—Washington. *Sierra Club B.* **6** (1907): 87–99. **Davidson.**

The name "Mount Rainier." By George Davidson.

Urges the retention of this name given by Vancouver, as against the proposed change to "Tacoma."

United States—Western. *Monthly Weather Rev.* **34** (1906): 557–559. **Henry.**

Salton Sea and the rainfall of the south-west. By Prof. Alfred J. Henry.

Shows that the Salton sea is unlikely to appreciably affect the local rainfall, though it may slightly increase the relative humidity.

United States—Wyoming and Montana. **Darton.**
U.S. Geol. Surv., Prof. Paper 51 (1906): pp. 130.

Geology of the Bighorn mountains. By N. H. Darton. *With Maps, Plates, and Sections.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Meteorology—Evaporation. *Sc. P. R. Dublin S.* **11** (1907): 137–178. **Sutton.**

A Contribution to the Study of Evaporation from Water-surfaces. By J. R. Sutton. *With Illustration.*

Many of the phenomena of evaporation are still so far a matter of uncertainty that the experiments here described are both of interest in themselves and useful as pointing to the need for further study.

Meteorology—Frost. *Meteorologische Z.* **24** (1907): 11–24, 49–64. **Dorscheid.**

Die mittlere Dauer des Frostes auf der Erde. Von Otto Dorscheid. *With Maps and Diagram.*

Meteorology—Pressure. *Z. Ges. E. Berlin* (1907): 246–253. **Baschin.**

Die geographische Verteilung des Luftdrucks und deren Änderung vom Sommer zum Winter. Von Otto Baschin.

Meteorology—Temperature. **Hann.**

Der tägliche Gang der Temperatur in der äusseren Tropenzone. A. Das Amerikanische und Afrikanische Tropenzone. Von Julius Hann. Wien, 1907. Size 12½ × 9½, pp. 88.

Meteorology—Upper Air. **Monaco.**

Meteorological Researches in the High Atmosphere. By H.S.H. the Prince of Monaco. (Reprinted from the *Scottish Geographical Magazine* for March, 1907.) [Edinburgh, 1907.] Size 9½ × 6, pp. 113–122. *Illustrations.*

Mountains. *Münchener G. Studien* **17** (1906): pp. vi. and 52. **Benl.**

Frühere und spätere Hypothesen über die regelmässige Anordnung der Erdgebirge nach bestimmten Himmelsrichtungen. Von Oskar Benl.

Mountains. *B.S. Belge Géol.* **20** (1906): Mém., 171–179. **Simoens.**
De la notion du temps nécessaire à la constitution d'une chaine plissée. Par G. Simoens.

Oceanography. **Krümmel.**
Handbuch der Ozeanographie. Von Dr. Otto Krümmel. Band I. Die raumlichen, chemischen, und physikalischen Verhältnisse des Meeres. Zweite . . . Auflage. (Bibliothek geographischer Handbücher, begründet von Friedrich Ratzel. Neue Folge herausgegeben von Prof. Dr. Albrecht Penck.) Stuttgart: J. Engelhorn, 1907. Size 9 × 6, pp. xvi. and 528. *Diagrams. Price* 22m. *Presented by the Publisher.* [To be reviewed.]

Oceanography. *B.S.G. Italiana* **8** (1907): 288–304. **Marini.**
Lo sviluppo, lo stato attuale e gli odierni problemi della Talassologia. Del prof. Lodovico Marini.

Oceanography—Baltic. **Fraude.**
X. Jahresber. G. Ges. Greifswald, 1905–06 (1907): 223–350.
Grund- und Plankton-Algen der Ostsee. Von Hermann Fraude. *With Map.*

Oceanography—Baltic. *Annalen Hydrographie* **34** (1906): 464–472. **Reinicke.**
Die Eisverhältnisse in den schwedischen und russischen Gewässern der Ostee im Winter 1905–06. Von G. Reinicke.

Oceanography—Baltic. *Annalen Hydrographie* **34** (1906): 391–398, 414–423. **Witting.**
Der Bottnische Meerbusen. Eine hydrographische Uebersicht. Von Rolf J. Witting. *With Charts and Sections.*

Oceanography—Currents. **Ekman.**
Annalen Hydrographie **34** (1906): 423–430, 472–484, 527–540, 566–583.
Beiträge zur Theorie der Meeresströmungen. Von V. Walfrid Ekman. *Diagrams.*

Oceanography—Indian Ocean. *C.R.A. Sc. Paris* **144** (1907): 405–407. **Thoulet.**
Fonds sous-marins entre Madagascar, la Réunion et l'île Maurice. Par J. Thoulet.

Oceanography—Museum.
Führer durch das Museum für Meereskunde in Berlin. Berlin: E. S. Mittler u. S., 1907. Size 8½ × 5½, pp. 152. *Illustrations. Presented by Prof. A. Penck.*

Oceanography—North Atlantic, etc. **Bouvier.**
B.I. Océanographique Monaco, No. **93** (1907): pp. 104.
Quelques impressions d'un naturaliste au cours d'une campagne scientifique de S. A. S. le Prince de Monaco (1905). Par E. L. Bouvier. *With Map and Illustrations.*

Oceanography—North Atlantic. *Z. Ges. E. Berlin* (1907): 173–176. **Mecking.**
Eisberge bei den Orkney-Inseln im Jahre 1836? Von D. L. Mecking.
Discusses the probability of the reported sighting of icebergs by Sir James Ross's ship *Cove.* A later note by Prof. Krümmel settles the question in the affirmative (p. 567, *ante*).

Oceanography—North Sea. **Thompson.**
Second report (northern area) on fishery and hydrographical investigations in the North Sea and adjacent waters. Conducted . . . under the superintendence of D'Arcy Wentworth Thompson. 1904–05. Part i. Hydrography. London, 1907. Size 13 × 8½, pp. iv. and 210. *Charts and Diagrams. Price* 4*s.* 2*d. Presented by the Fishery Board for Scotland.*

Oceanography—Pacific. *Queensland G.J.* **21** (1905–06): 71–134. **Murray.**
On the depth, temperature of the ocean waters, and marine deposits of the south-west Pacific Ocean. By Sir John Murray.
Read at the Queensland Geographical Society's Anniversary celebration (see *Journal,* vol. **28**, p. 514).

Oceanography—Pacific. *Annalen Hydrographie* **35** (1907): 108–113. **Schott.**
Lotungen I.N.M.S. "Edi" und des deutschen Kabeldampfers "Stephan" im westlichen Stillen Ozean. Von G. Schott. *With Charts.*
Noticed in the June number (vol. **29**, p. 679).

Oceanography—Plankton. **Schröder.**
Vierteljahrsschrift Naturfors. Ges. Zürich **51** (1906): 319–377.
Beiträge zur Kenntnis des Phytoplanktons warmer Meere. Von Bruno Schröder. *With Illustrations.*

Oceanography—South Pacific. **Haswell and others.**
Records Australian Museum **6** (1907): 271–311.
The results of deep-sea investigation in the Tasman Sea. I. The expedition of H.M.C.S. *Miner*. By W. A. Haswell, C. Hedley, and E. J. Goddard. *With Illustrations.*

Oceanography—Terms. *Riv. G. Italiana* **13** (1906): 441–452, 523–531. **Ricchieri.**
Terminologia morfografica dei fondi oceanici. Considerazioni e proposte del Prof. Giuseppe Ricchieri.
Criticism, in matters of detail, of the recommendations of the international committee (*Journal*, vol. **22**, p. 191).

Oceanography—Voyage. *Annalen Hydrographie* **35** (1907): 145–149. **Schott.**
Kapitänleutnant Lebahn und die Forschungsreise S.M.S. *Planet*. Von Gerhard Schott. *With Chart.*

Oceanography—Voyage. **[Lebahn.]**
Annalen Hydrographie **34** (1906): 145–147, 220–227, 259–265, 305–313, 353–365, 409–414, 457–464, 505–510, 556–562.
Die Forschungsreise S.M.S. *Planet*. *With Charts, Diagrams, and Illustrations.*
See note in the January number (p. 94).

Phytogeography. *T. Nat. Hist. S. Glasgow* **7** (1904–05): 225–235. **Ewing.**
An Œcological Problem. By Peter Ewing.
Discusses the relation of alpine plants to the rocks on which they are found. (See p. 330, *ante*.)

Rivers. *Riv. G. Italiana* **14** (1907): 95–78. **Issel.**
Il concetto della direzione nei corsi d'acqua. Nota di A. Issel. *With Diagrams.*
Discusses the different senses in which the idea of direction is applicable to the course of a waterway. (See July number, p. 95.)

Sea-level. *Geological Mag.*, Dec. v., **4** (1907): 115–121. **Pearson.**
Deformation and variation in the sea-level. By H. W. Pearson.

Seismology. *Atti R. A. Lincei, Ser.* V., *Rendiconti* **16** (1907): 1 Sem., 384–395. **Marchi.**
Teoria elastica delle dislocazioni tectoniche. Nota di L. De Marchi.

Seismology. **Upham.**
The San Francisco and Valparaiso earthquakes and their causes. By Warren Upham. (From the *Transactions* of the Victoria Institute.) [London, 1907.] Size 8½ × 5½, pp. 18. *Map.*

Snow. *Alpine J.* **23** (1907): 379–386. **Hoek.**
On snow avalanches. By Dr. H. Hoek.

Zoogeography. *Report Smithsonian I.* (1905): 375–402. **Allen.**
The influence of physical conditions in the genesis of species. By Joel A. Allen.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Historical—Marco Polo. *Riv. G. Italiana* **14** (1907): 107–108. **Vacca.**
Un manoscritto inedito del viaggi di Marco Polo. Di Giovanni Vacca.
Refers to a Catalan manuscript in a script resembling that of the famous Catalan Atlas of 1375, which it is thought to precede in date.

Historical—Navigation. *M.G. Ges. Hamburg* **21** (1906): 63-176. **Behrmann.**
Ueber die niederdeutschen Seebücher des funfzehnten und sechzehnten Jahrhunderts. Von Dr. Walter Behrmann. *With Facsimile maps, and Illustrations.*

Medical Geography. **Brunton.**
The Influence of Climate upon Health and Disease. By Sir Lauder Brunton. (Paper . . . at the British Association, Cape Town, 1905.) Size 8½ × 5½, pp. 20.

Missions.
Outline History of C.M.S. Missions. Vol. 3. London: Church Missionary Society, 1907. Size 7½ × 5, pp. 160. *Maps. Presented by the Publishers.*

GENERAL.

Geography. *G. Teacher* **4** (1907): 19-28. **Unstead.**

The meaning of geography. By J. F. Unstead.

Photography—Pocket-book.

Wellcome's photographic exposure record and diary, 1907. London, etc.: Burroughs Wellcome & Co., [*not dated*]. Size 5½ × 3, pp. 268. *Illustrations.*

An earlier issue of this useful pocket-book (in which minor improvements are constantly introduced) was noticed in vol. **25**, p. 335.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Denmark. **Danish General Staff.**

Topografisk Kaart over Kongeriget Danmark. Scale 1: 40,000 or 1·6 inch to 1 stat. mile. Sheets: Amager, Anholt, Ballerup, Hesnæs, Höje Taastrup, Kjöbenhavn, Marienborg, Nykjöbing (Falster), Sommerspiret, Svaneke, Vigsnæs. Copenhagen: Danish General Staff, 1906–1907. *Presented by the Danish Government.*

England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from September 1 to 30, 1907.

4 miles to 1 inch:—

County Diagrams, showing Civil Parishes, with a table of their areas—**Radnorshire, Warwickshire.** *Price* 6*d. each.*

2 miles to 1 inch:—

Large-sheet series, printed in colours, folded in cover or flat in sheets, 10, 25. *Price, on paper,* 1*s.* 6*d.*; *mounted on linen,* 2*s.*; *mounted in sections,* 2*s.* 6*d. each.*

1 inch—(third edition):—

In outline, 208, 335. 1*s. each* (engraved).

With hills in brown or black, 90, 346, 358. 1*s. each* (engraved).

Towns and country around, with roads printed in colour. Cardiff. *Price, on paper,* 1*s.*; *mounted on linen,* 1*s.* 6*d.*

Large-sheet series, printed in colours, folded in cover or flat in sheets, 13, 19, 22, 97. *Price, on paper,* 1*s.* 6*d.*; *mounted on linen,* 2*s.*, *mounted in sections,* 2*s.* 6*d. each.*

6-inch—County Maps (first revision):—

Carmarthenshire, 12 S.E., 27 S.W., 29 N.E., S.E., 33 N.E., S.E., 34 N.E., 35 S.W., 38 N.W., 40 N.W., 41 N.W., N.E., 46 S.W., 49 N.W., S.E. **Cornwall,** 28 S.W. **Devonshire,** 104 S.E., 124 N.W. **Lincolnshire,** 25 S.E., 26 N.E., S.E., 27 N.E., 30 S.E., 36 S.E., 40 S.W., 41 S.E. **Norfolk,** 75 S.W. **Pembrokeshire,** 2 S.W., (3 S.E. and 7 N.E.), 6 N.E., (7 N.E. and 3 S.E.), 12 N.W. **Yorkshire (First Revision of 1891 Survey),** 264 S.W., 265 N.W., 266 S.W., 278 S.W., 281 S.W. 1*s. each.*

25-inch—County Maps:—

Cornwall (First Revision), XLVII. (12 and 8); XLVIII. 5, 9, 13; L. 8; LVI. 3, 7, 8, 11; LVII. 1; LVIII. 6, 14, 15; LIX. 8; LXV. 7, 15; LXXII. 1, 6, 9, 14; LXXXIV. 10. **Kent** (Second Revision), XXII. 14; XXIII. (7 and 11), 9, (11 and 7), 12, 13, 14, 16; XXIV. (6 and 5), 7, 9, 10, 11, 13, 14; XXXIV. 2, 3, 4, 6, 7, 8, 10, 11, 12, 14, 15, 16; XXXV. 1, 5, 9, 10, 13, 14, 16; XXXVI. 2, 3, 13; XLV. 2, 3, 4, 8, 12, 14, 15, 16; XLVI. 1, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13; XLVII. 1, 5, 9; LV. 2, 3, 4, 6, 7, 8, 10, 11, 12, 14; LVI. 1, 5, 9; LXV. 3, 8; LXVI. 1; LXVIII. 13, (14 and 15); LXXIV. 1. 3*s. each.* **Lancashire (First Revision of 1891 Survey),** CVIII. 3, 4, 7, 8, 9, 10, 13; CXI. 2; CXIV. 1, 5. **Lincolnshire** (First Revision), IX. 10, 11, 12, 16; XXI. 6. 3*s. each.* IX. 4, 6, 7. 1*s.* 6*d. each.* **Norfolk** (First Revision), LXXV. 8, 12; LXXVI. 5, 6, 7, 8, 10, 11, 12, 14, 15, 16; LXXVII.

5, 9, 10, 13; LXXXVIII. 4; LXXXIX. 1. **Pembrokeshire** (First Revision), VIII. 11, 13, 14, 15, 16; IX. 9, 13; XV. 1, 4, 5, 6, 7, 8; XVI. 1, 5, 12; XVII. 5, 13; XXI. 4; XL. 15, 16; XLI. 13, 14; XLIII. 3, 4; XLIV. 1, 2, 5. **Yorkshire** (First Revision of 1891 Survey). CCXXIX. 3, 4, 7, 11, 12, 16; CCXXX. 11, 16; CCXXXIII. 12; CCXXXVI. 5, 6, 11, 12, 13, 14, 16; CCXLIX. 3, 4. *3s. each.* CCLIII. 16. *1s. 6d.*

(*E. Stanford, London Agent.*)

England and Wales. **Geological Survey.**

1-inch map—New Series. Colour printed. Penzance (351 and 358 combined). *2s. 6d.*

(*E. Stanford, London Agent.*)

England—London. **Stanford.**

Stanford's special map of the railways and electric tramways of London and its environs. Scale 1 : 63,360 or 1 inch to 1 stat. mile. London: Edward Stanford. 1907. *Price* 1*s.*

France. **Service Géographique de l'Armée, Paris.**

Carte de la France dressée par ordre du Ministre de l'Intérieur. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets: x.–13, Vire; xvii.–35, St. Pons; xvii.–39, Céret; xx.–25, Amplepuis; xxi.–24, Beaujeu; xxvi.–25, Chamonix. Paris: Service Géographique de l'Armée, Service Vicinal, 1907. *Price* 0.80 *fr. each sheet.*

Germany. **K. Preuss. Landesaufnahme.**

Karte des Deutschen Reiches. Herausgegeben von der Kartographischen Abteilung der Kgl. Preuss. Landesaufnahme. Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. Sheets (coloured), 264, Klötze; 265, Gardelegen; 289, Obisfelde; 290, Neuhaldensleben. Berlin: K. Preuss. Landesaufnahme, 1906. *Price* 1.50*m. each sheet.*

Turkey. **Topographical Section, General Staff.**

Map of Turkey. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheets: Rodosto; Vize. London: Topographical Section, General Staff, War Office, 1907. *Price* 2*s.* 6*d. net each sheet. Presented by the Director of Military Operations.*

These are two sheets of the map of Turkey noticed in the *Geographical Journal* for July, 1906. They adjoin the Constantinople sheet—one, "Vize," to the north; and the other, "Rodosto," to the west. Relief is shown by approximate contours in brown at intervals of 100 feet.

ASIA.

Asia. **Johnston.**

The World-wide Series of Library and Office Maps. Asia. Scale 1 : 9,218,880 or 1 inch to 145·5 stat. miles. Edinburgh: W. & A. K. Johnston, [1907]. *Price* 15*s. Presented by the Publisher.*

A general map of Asia upon which political boundaries, principal railways, etc., seem to have received careful attention. The unnecessarily heavy colouring renders the names and detail somewhat indistinct. As regards geographical features, the map in parts needs more thorough revision to bring it up to date. This is specially the case with regard to Tibet.

China. **Willis.**

Geologische Karten der Distrikte Sin-t'ai und Ch'ang-hia (Provinz Shan-tung). Von Bailey Willis. Scale 1 : 175,000 or 1 inch to 2·7 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1907, Tafel 18. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

Daghestan. **Dirr.**

Sprachenkarte des Mittellaufes des Andischen Koissu (Daghestan). Von A. Dirr. Scale 1 : 420,000 or 1 inch to 6·6 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1907, Tafel 17. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

AFRICA.

British East Africa. **Topographical Section, General Staff.**

British East Africa. Lumbwa and Sotik reconnaissance map. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. London: Topographical Section, General Staff, War Office, 1907. *Price* 2*s. Presented by the Director of Military Operations.*

A preliminary reconnaissance of the country immediately east and south-east of

Kavirondo gulf, Victoria Nyanza. The relief is shown by four lines in brown at approximate 200-feet intervals.

Cape Colony. **Topographical Section, General Staff.**

Map of Cape Colony. Reconnaissance Series. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheets: 127-E, Orange River mouth; 127-F, Stinkfontein; 127-K and L, Port Nolloth and O'Okiep; 128-R, Britstown. London: Topographical Section, General Staff, War Office, 1907. *Presented by the Director of Military Operations.*

Congo State. **Department of the Interior, Congo Free State Government**

Carte politique de l'État Indépendant du Congo, 1907. Scale 1 : 4,000,000 or 1 inch to 63·1 stat. miles. Brussels, 1907. *Presented by the Secretary, Department of the Interior, Congo Free State Government.*

This small official general map is important, inasmuch as it shows the partition of the Congo Free State into districts, as well as railways constructed and proposed, and telegraphs. Waterways navigable for steamers are coloured blue, while those not so navigable are left uncoloured. An index to the positions, government stations, or posts, is given at the side of the map.

Congo State. **Dept. of the Interior, Congo Free State Government.**

Carte du District du Kasai. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. Brussels: Falk Fils, 1907. *Presented by the Secretary, Department of the Interior, Congo Free State Government, Brussels.*

A route-map compiled principally from sketches and compass traverses made by the Congo Free State officials while passing between the different stations in the execution of their duties. The map contains far more detailed information than any other of the district that has hitherto appeared. Routes are shown in red, water blue. Maps of other districts have been prepared on the same scale. Doubtless the information they contain will be available to the public on the 1 : 1,000,000 map of the whole state which it is understood will be published next year.

Egypt. **Survey Department, Cairo.**

Provisional map of Beheira Mudiria. Scale 1 : 125,000 or 1 inch to 1·9 stat. mile. 4 sheets. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

The Beheira Mudiria includes Alexandria and the western section of the delta of the Nile. Names and notes are in native character and English.

Egypt. **Survey Department, Cairo.**

Topographical map of Fayum Province. Scale 1 : 10,000 or 6·3 inches to 1 stat. mile. Sheets: S.W. 15-6, 15-8, 15-9, 15-10, 15-11, 15-12, 15-13, 16-1, 16-2, 16-4, 16-5, 16-6, 16-7, 16-8, 16-9, 16-10, 16-11, 16-12; S.E. 16-1. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Gold Coast. **Guggisberg.**

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1 : 125,000 or 1 inch to 1·9 stat. mile. Sheet 71 K I. Comassie (Kumase). Edinburgh and London: W. & A. K. Johnston, 1907. *Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.*

Orange River Colony. **Topographical Section, General Staff.**

Map of Orange River Colony. Scale 1 : 125,000 or 1 inch to 1·9 stat. mile. Sheets: 127-U-II., Bothaville; 127-U-IV., Odendaals Rust. London: Topographical Section, General Staff, War Office, 1906. *Presented by the Director of Military Operations.*

Tunis. **Babelon, Cagnat, and Reinach.**

Atlas archéologique de la Tunisie. Édition speciale des cartes topographiques publiées par le Ministère de la Guerre accompagnée d'un texte explicatif par MM. E. Babelon, R. Cagnat, S. Reinach. 10e et 11e Livraison. Paris: Ernest Leroux, 1905.

AMERICA.

Canada. **Dept. of the Interior, Ottawa.**

Sectional map of Canada. Scale 1 : 190,080 or 1 inch to 3 stat. miles. Sheet: Victoria, revised to July 30, 1907. Ottawa: Department of the Interior, Topographical Surveys Branch, 1907. *Presented by the Department of the Interior, Ottawa.*

Canada. **Johnston.**

Commercial and School Wall-map of the Dominion of Canada. Scale 1 : 2,770,000 or 1 inch to 44 stat. miles. Edinburgh: W. & A. K. Johnston. Toronto: George M. Hendry Co., 1907. *Price* £1 7*s.* 6*d.* *Presented by Messrs. W. & A. K. Johnston.*

This is a good and clearly executed general map of the Dominion of Canada suitable for hanging in schools or offices. It has been compiled from the latest information, special attention being paid to railways, river systems, and boundaries. This relief is boldly and somewhat roughly indicated by brown shading. The natural products of the various districts are given in red, but these cannot be considered as at all complete, although giving an idea of some of the more leading products only. The map measures 84 inches × 50 inches, and can be obtained at the same price either mounted to fold in cloth case or on rollers varnished to hang on a wall.

Chile. **Oficina de Limites, Santiago.**

Comision Chilena de Limites. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Sheets: Llanquihue, lat. 46° S. to 47° S.; Magallanes, lat. 47° to 48° S.; Magallanes, lat. 48° S. to 49° S. Santiago: Oficina de Limites, 1907. *Presented by the Director, Oficina de Limites, Santiago.*

Additional sheets of the surveys of the Chilian Boundary Commission, similar in style to those already noticed in the *Geographical Journal*. In each case the topographical sheet is accompanied by one showing the lines of traverses and intersected points upon which the survey was chiefly based.

GENERAL.

Time Dial. **Gregory.**

Philips' Standard Time Dial. Designed by Prof. R. A. Gregory, F.R.A.S., Professor of Astronomy, Queen's College, London. London: George Philip & Son, Ltd., 1907. *Price* 3*s.* 6*d. net.* *Presented by the Publisher.*

For showing the relative time of the principal cities and countries of the world, and the relation between time and longitude generally, there is nothing to be compared with globes for educational purposes; but these are costly and inconvenient in size, so several attempts have been made to construct movable diagrams for the purpose. Some of these have been fairly successful, but they have frequently proved unsatisfactory for teaching through lack of simplicity and clearness, or on account of the distortion due to the projection employed. Prof. R. A. Gregory has now produced a diagram on a thick board, suitable for schools, which has decided advantages over any hitherto published. This consists of the usual clock-face dial divided in twenty-four hours, with a revolving map, on a card, in the centre; but instead of attempting to show the whole world, necessarily much distorted, on one map, as has been done before, the diagram is reversible, and upon one face, a map of the northern hemisphere only is shown, while upon turning the diagram over will be found another clock-dial, similar to the first, with the southern hemisphere on the revolving card in the centre. This division of the globe at the equator is a great improvement, and renders the diagram far more intelligible to children. Upon the maps the Greenwich meridian is shown by a thick line, while the different "time zones" are also indicated, so that the local standard time can be found which corresponds to any particular Greenwich time.

World. **Harmsworth.**

Harmsworth Atlas and Gazetteer. Parts 24 and 25. London: The Amalgamated Press, Ltd., 1907. *Price 7d. each part.*

These parts contain the following maps: Part 24, Nos. 43, South-East Ireland; 44, Plans of London, Edinburgh, and Dublin; 97–98, Central and South Russia; 183–184, West Indies. Part 25, Nos. 37–38, Ireland, railway systems; 65–66, Eastern Switzerland; 149–150, Natal, Transvaal, and Orange River Colony.

World. **Morrison.**

Bacon's Elementary Relief Atlas containing thirty-six plates of coloured relief and political maps of the world, with index. Edited by Marcus G. Morrison, F.R.G.S. London: G. W. Bacon & Co., Ltd., [1907]. *Price* 8*d.* *Presented by the Editor.*

Mr. M. G. Morrison has here attempted to produce a cheap little general atlas for elementary educational purposes that shall be, as far as the means placed at his disposal would allow, on the more approved and intelligent lines of recent times. In order to give young scholars a general idea of the leading physical features of the continents and principal countries, he has placed by the side of the political map a photographic reproduction of a model on the same horizontal scale, with an effect

that is decidedly graphic if not altogether accurate. The chief fault, which indeed is common to many such attempts, is the exaggerated idea of height conveyed, and in places, the lack of true proportion between lower and higher elevations. A nicely drawn little map of the whole world on Mollweide's elliptical projection, showing relative heights by tinting, is given at the commencement of the atlas, together with other general diagrams and plans. There are altogether thirty-six sheets of maps and diagrams, and if the execution of some of them is rather rough and crude, it must be remembered that the price is very low, and too much cannot be expected for the modest sum of eightpence. There is an index to place-names.

Charts.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during August, 1907. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
2881 m =	1·4 3·6 3·6	Gulf of Mexico:—Key West harbour and approaches. Plans of Key West harbour and north-west channel bar. 3*s*.
1739 m =	2·9	China:—Chu-Kiang or Canton river, sheet V. Whampoa channel and Changshan island to Canton. 3*s*.
3649 m =	2·9	Tasmania, north coast:—Entrance to river Tamar. 3*s*.

New Plans and Plans added.

2799 m =	2·0 1·5	South America, west coast:—Plans on the coast of Ecuador and Peru. Plan added:—Port Bayovar. 2*s*.
1115 m =	—	China, north-east coast:—Yang tse kiang, sheet V. Yo-chau-fu to Kwei-chau-fu. Plans added:—Sketch of Tching Tan. Sketch of Kung Ling Tan. 4*s*.
1268 m =	1·9 3·9	Plans in the Kuril islands. Plans added:—Shari road, Rausu road. New plan:—Anama harbour. 2*s*.

Charts Cancelled.

No.	Cancelled by	No.
2881 Gulf of Mexico:—Key West harbour and approaches. Plan of Key West harbour.	New chart. Key West harbour and approaches. Plan of Key West harbour, plan of north-west channel bar	2881
1739 China:—Canton river, sheet V. Whampoa channel and Changshan island to Canton. Index sheet of Canton river.	New chart. Chu Kiang or Canton river, sheet V. Whampoa channel and Changshan island to Canton	1739
1080 Tasmania, north coast:—River Tamar from the sea to Launceston. Plan of Port Dalrymple on this sheet.	New chart. Entrance to river Tamar	3649

Charts that have received Important Corrections.

No. 1188, The World:—Coal and Telegraph chart. 1481, Scotland, east coast:—River Tay. 2495, Ireland, south coast:—Kenmare river, etc. 3158, Norway:—Nevlunghavn to Torbiornskier, etc. 3159, Norway:—Torbiornskier to Jælöen. 881, Norway:—Aakre to Hisken, etc. 2309, Norway, sheet VII.—Leka to Donnæsö. 2628, Malta island, south-east portion. 644, Africa, east coast:—Delagoa bay (*Lorenzo Marques*). 216*a*, Bay of Bengal, Mergui archipelago:—Lord Loughborough island to Mergui. 3612, China, south coast:—Port Shelter and Rocky harbour. 1760, China, east coast:—The Brothers to Ockseu islands, etc. 2513, New Zealand:—Napier port and harbour.

Danish Chart. **Danish Admiralty.**

Danish Hydrographic Charts. Nos.: 213, Islands Westkyst, Reykjavik og Hafnarfjords med Omgivelser; 214, Islands Ostkyst, Langanes-Vestrahorn. Copenhagen: Danish Admiralty, 1907. *Presented by the Danish Admiralty.*

Indian Ocean and Red Sea. **Meteorological Office.**

Monthly meteorological chart of the Indian ocean north of 15° S. lat. and Red

sea, October, 1907. London: Meteorological Office, 1907. *Price* 6*d. each. Presented by the Meteorological Office.*

Mersey River. **Belam and Ashton.**

Chart of the River Mersey from Rock Lighthouse to Warrington Bridge, 1906. By Commander Henry Belam, M.V.O., R.N., Marine Surveyor, and H. G. G. Ashton, F.R.G.S., Assistant Marine Surveyor, Mersey Docks and Harbour Board. Scale 1:38,400 or 1·65 inch to 1 stat. mile. Liverpool: Mersey Docks and Harbour Board, 1906. *Presented by H. G. G. Ashton, Esq.*

This is a continuation of the chart previously published by the same authors, and extends from New Brighton to Warrington, thus including the lower course of the Manchester Ship Canal. It shows the position of sandbanks, in addition to many lines of soundings taken at close intervals across the river, but has evidently been reduced by photography from a much larger drawing, with the result that the figures, details, and smaller lettering are in many places illegible without the aid of a glass.

North Atlantic and Mediterranean. **Meteorological Office.**

Monthly meteorological chart of the North Atlantic and Mediterranean, October, 1907. London: Meteorological Office, 1907. *Price* 6*d. each. Presented by the Meteorological Office.*

North Atlantic. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic ocean, September, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific ocean, October, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Arabia and Persia. **Wilson.**

Thirty-one photographs of Arabia and Persia, taken by A. T. Wilson, Esq. *Presented by A. T. Wilson, Esq.*

A remarkably good set of photographs depicting places of interest in Southern Persia and along the shores of the Persian gulf. They also give a good idea of the scenery characteristic of the region. The following are the titles:—

(1) Maskat; (2) Fort and beach, Jask; (3) Native village, Hormuz island; (4) The old Portuguese fort, Hormuz island; (5) The fort and beach, Hormuz island; (6) Fort, beach, and village, Hormuz island; (7) Camels drinking at well near Bandar Abbas; (8) Desert near Naband, Kuh-i-Ginao in distance; (9) Bandar Abbas, old British consulate at Naband; (10) Bandar Abbas, quarantine station; (11) Bandar Abbas, view from Naband; (12) Desert near Khana Surkh; (13) Wind-eroded rocks near Gatchin; (14) Tang-i-Chakabak; (15) Birkeh Sultan, serai and cistern; (16) Rudare valley; (17) Valley of the Rasul river; (18) Sunset near Birkeh Nuh; (19) Date grove near Sartang; (20) Temporary bridge near Abbasabad, Kara Agatch river; (21) Entrance of Kara Agatch river into Tang-i-Tadun; (22) Exit of Kara Agatch river from Tang-i-Tadun; (23) Kara Agatch valley from hills east of Azimungird; (24) Sarvistan valley, from hills east of Azimungird; (25) Kara Agahh valley from above Kunjun; (26) Lake Maharlu from Kunjun; (27) Lake Maharlu from near Goshnakun; (28) Tomb of Hafiz, Shiraz; (29) Entry of governor into Shiraz, artillery; (30) Entry of governor into Shiraz, escort; (31) Entry of governor into Shiraz, band of camels.

Ceylon. **Varley.**

Eleven photographs of Ceylon, taken by F. J. Varley, Esq., Indian Civil Service. *Presented by F. J. Varley, Esq.*

Mr. Varley's latest addition to our collection consists of the following small photographs of Ceylon:—

(1) Pidrutalagala mountain, from Nuwara Eliya; (2–4) Views from summit of Pidrutalagala; (5 and 6) Views of the lake at Nuwara Eliya; (7) Tea estates and mountain railway, Nuwara Eliya; (8) Falls near Nuwara Eliya; (9) View on road to Kandapola; (10) Hakgala mountain; (11) Diyatalava, with Boer prisoners' camp.

Congo State. **Torday.**

Five photographs of the Congo State, taken by E. Torday, Esq. *Presented by E. Torday, Esq.*

Mr. E. Torday has visited the comparatively little-known region of the Kuilu,

which flows into the Kasai, and his photographs are of considerable interest. They are extremely clear, and measure 4¾ inches by 6¾ inches.

(1) Kweti, the Lukengu (king) of the Bakubas; (2) Kweti, the Lukengu (king) of the Bakubas with his household; (3) A Bakuba petty chief; (4) Native fisheries; (5) The Zambezi river.

India. **Ritchie.**

Twenty-nine photographs of India, taken by Captain C. MacI. Ritchie, R.H.A.
Presented by Captain C. MacI. Ritchie, R.H.A.

The photographs of Kashmir were taken in March, April, and May of the present year, while those of Gahrwal and the Deccan were taken in August and December, 1899. They measure 3¼ inches by 4¼ inches. The titles are as follows:—

Garhwal:—(1) View on the upper Ganges near Harsil; (2) A hillman of Garhwal; (3 and 4) Suspension bridge at Bhaironghatti; (5) Gorge over which the bridge spans at Bhaironghatti; (6) Inhabitants of Nilang; (7–13) Scenery north of Nilang; (14) Dawn, at a high temporary camp. Kashmir:—(15) The Aijas nullah; (16) A "Bara Singh;" (17) Limber nullah; (18 and 19) Scenery in the Kaj-Nag; (20) A Markhor; (21) Summit of the Rajdiangan pass; (22) View from summit of the Rajdiangan pass looking towards Gurais; (23) Cantilever bridge over the Kishenganga; (24) Head of the Gagai nullah; (25) A red bear. The Deccan:—(26) Starting from camp; (27) Beaters collecting; (28) A toddy palm-tree race; (29) Elephants waiting to be fed.

Kalahari Desert. **Hodson.**

Fifty-eight photographs of the Kalahari Desert, taken by A. Wienholt Hodson, Esq.
Presented by A. Wienholt Hodson, Esq.

Mr. Hodson has travelled extensively in the Kalahari, and taken advantage of his opportunities for obtaining an interesting series of small photographs, which have been placed in an album and presented to the Society. The first fifty-two of these were taken a few years ago, and the last seven, of more recent date, have been added since. The whole series give a good idea of the scenery and natives of this remarkable region.

(1) Kalahari native in hartebeeste's skin, Kakong; (2) Scotch cart and oxen; (3) Damaras at Nga; (4) Biltong; (5) Women stamping berries, Ngoatle; (6) Women with ostrich eggs filled with water, Kakong; (7) Basuto orderly, Gaberones; (8) Kooi Pan; (9) Proctor's store, Gukuusi; (10) Springbuck, Kooi; (11) Oxen eating melons, Ngoatle; (12) Kalaharis with Pamo, Ngoatle; (13 and 34) Horses eating melons, Ngoatle; (14) Hottentot with ostrich feathers and springbuck; (15) Gemsbuck; (16) Wild ostrich and Hottentot; (17) Stembuck, Kooi; (18) Dead hartebeeste on pack-bullock; (19) Kalaharis with melons, Ngoatle; (20) Damara with bow and arrow; (21) Melons and cart, Nga; (22) Trader's camp; (23) Damaras; (24) Okavango river; (25) Drying melons for food, Otse; (26) Kalahari women; (27) Women with grass; (28) Damaras, Otse; (29) Kalahari boy and woman, Kakong; (30) Bushmen in hut; (31) Bushman baby; (32) Packing bullock with makatans, Otse; (33) Basuto on riding-ox, Otse; (35) Pack-oxen; (36) Travelling waggon; (37) Group of bushmen; (38 and 45) Cart and oxen; (39) Fort Gaberones; (40) Native escort; (41) Hotel, Mafeking; (42) Camp, Mafeking; (43) Officers' quarters, Mafeking; (43) Hartebeeste; (44) Cart in Nosob river; (46) Kakea Pan; (47) Makatans; (48) A Mongwato woman and baby; (49) A Mongwato baby; (50) Bamangwato children playing; (51) My camp at Lephepe; (52) A water-hole in the Kalahari desert during the rainy season; (54) Native herding cattle in Kalahari desert; (55) Five days' sport in the Kalahari desert.

Vegetation Types. **Karsten and Schenck.**

Vegetationsbilder herausgegeben von Dr. G. Karsten und Dr. H. Schenck. Fünfte Reihe. Heft 3–5, Vegetationsbilder aus Nordrussland. Von Dr. Richard Pohle. Heft 6, Spanien. Von Dr. M. Rikli. Heft 7, Deutsch-Ostafrika. I. Zentrales Steppengebiet. Jena: Gustav Fischer, 1907. *Price* 4*m. each part.*

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

150°

REFERENCE.

Metres.		Feet.
2000	=	6562.
1000	=	3281.
200	=	656.
Sea Level		**Fathoms.**
200	=	109
400	=	219
600	=	328
1000	=	547
2000	=	1094
3000	=	1640

Ocean Depths on Chart shown in Metres and Fathoms thus 156 M. (85 F.)

AMERICA

BERING STRAIT

57 M. (31 F.)

49 M. (27 F.)

HERALD I.

55 M. (30 F.)

64 M. (35 F.)

Pt. Barrow

119 M. (65 F.)

120°

BEAUFORT SEA

BANK I.

Mc Clure Str.

PRINCE PATRICK I.

PARRY ISLANDS

QUEEN MAUD SEA

Mc CLINTOCK CHAN.

RINGNES ISLANDS

AXEL HEIBERG I.

90°

NORTH

KAFFIN BAY

BAFFIN I.

3200

GREENLAND

60°

ICELAND

FARÖE I.

30°

Published by the Royal G

THE GEOGRAPHICAL JOURNAL 1907.

BATHYMETRICAL CHART OF NORTH POLAR SEAS BY Dr. FRIDTJOF NANSEN.

Nat. Scale 1: 20,000,000 or 1 Inch = 315·6 Stat. Miles.

100 0 100 200 300 400 500

180° 150° 120° 90° 60° 30° 0°

70°

80°

WRANGELL I.

26 M. (14 F.)

70 M. (38 F.)

156 M. (85 F.)

Jeanette I.

Henrietta I.

32 M. (17 F.)

NEW SIBERIA IS.

Bennett I.

100 M. (55 F.)

32 M. (17 F.)

66 M. (36 F.)

124 M. (68 F.)

C. Cholyuskin

Taimur Peninsula

Ensomheden I.

84 M. (46 F.)

FRANZ JOSEF LD.

SPITSBERGEN

BARENTS SEA

NOVAYA ZEMLYA

OBEAN I.

WHITE SEA

SCANDINAVIA

BALTIC SEA

SCOTLAND

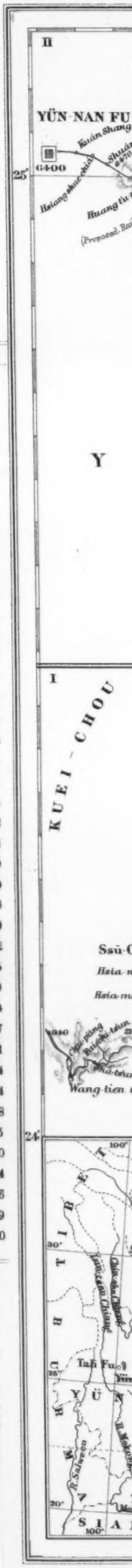
SIBERIA

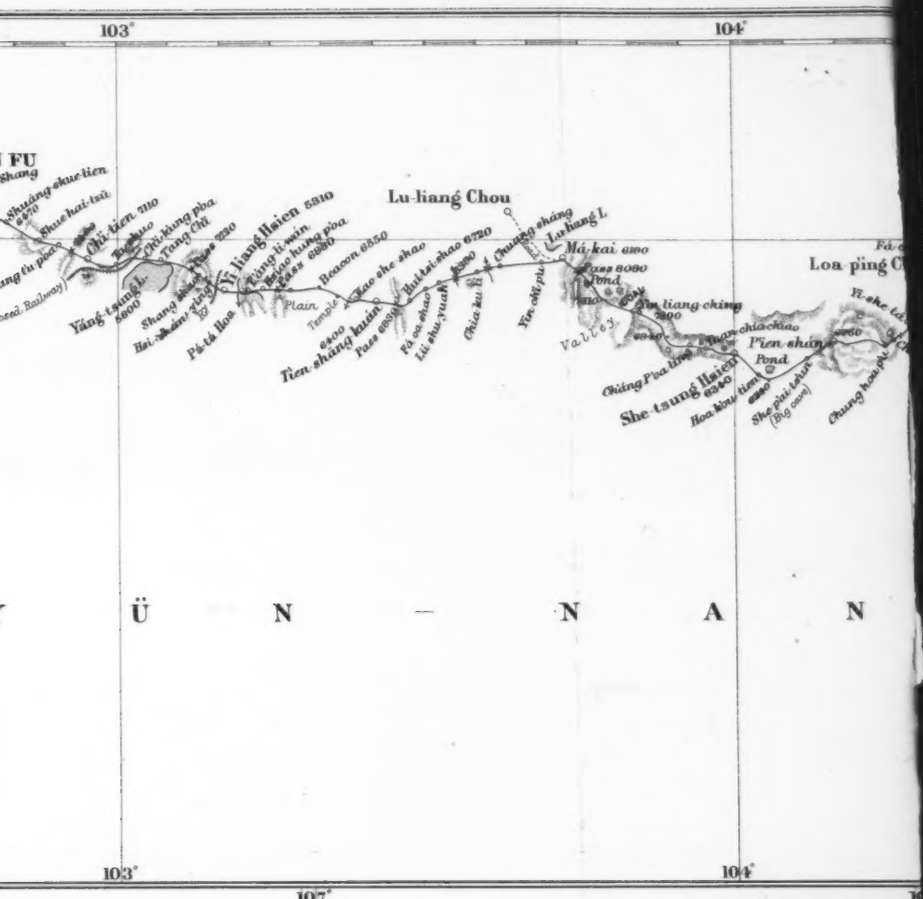
EUROPE

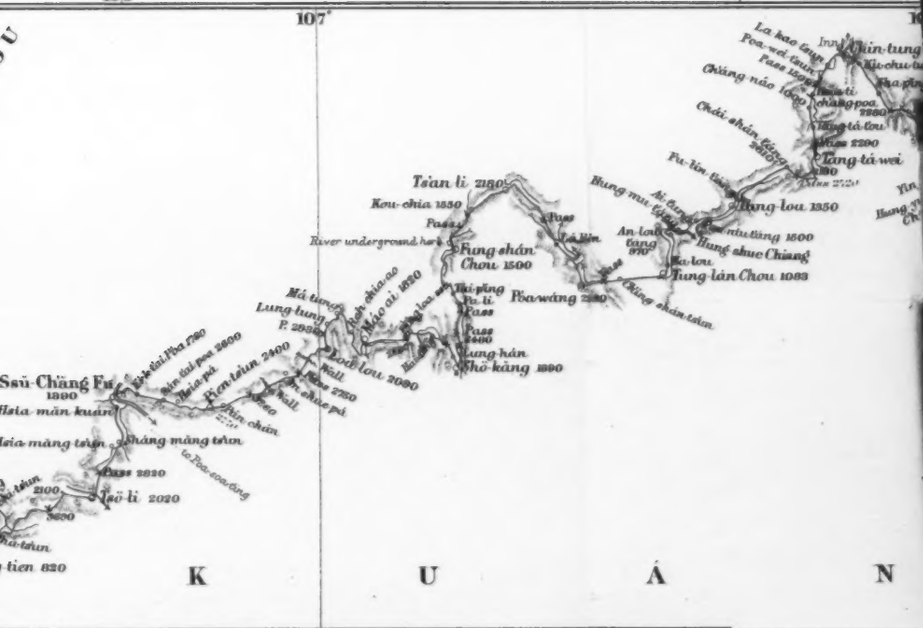
Royal Geographical Society.

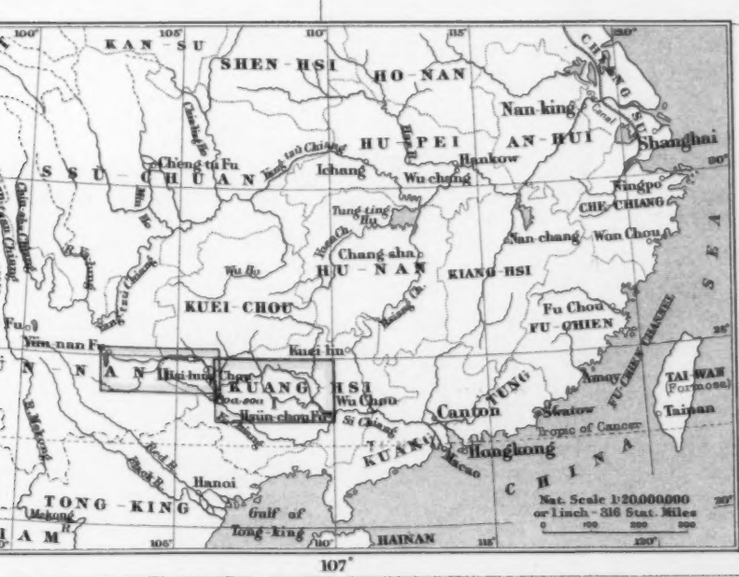
LIST OF POSITIONS.

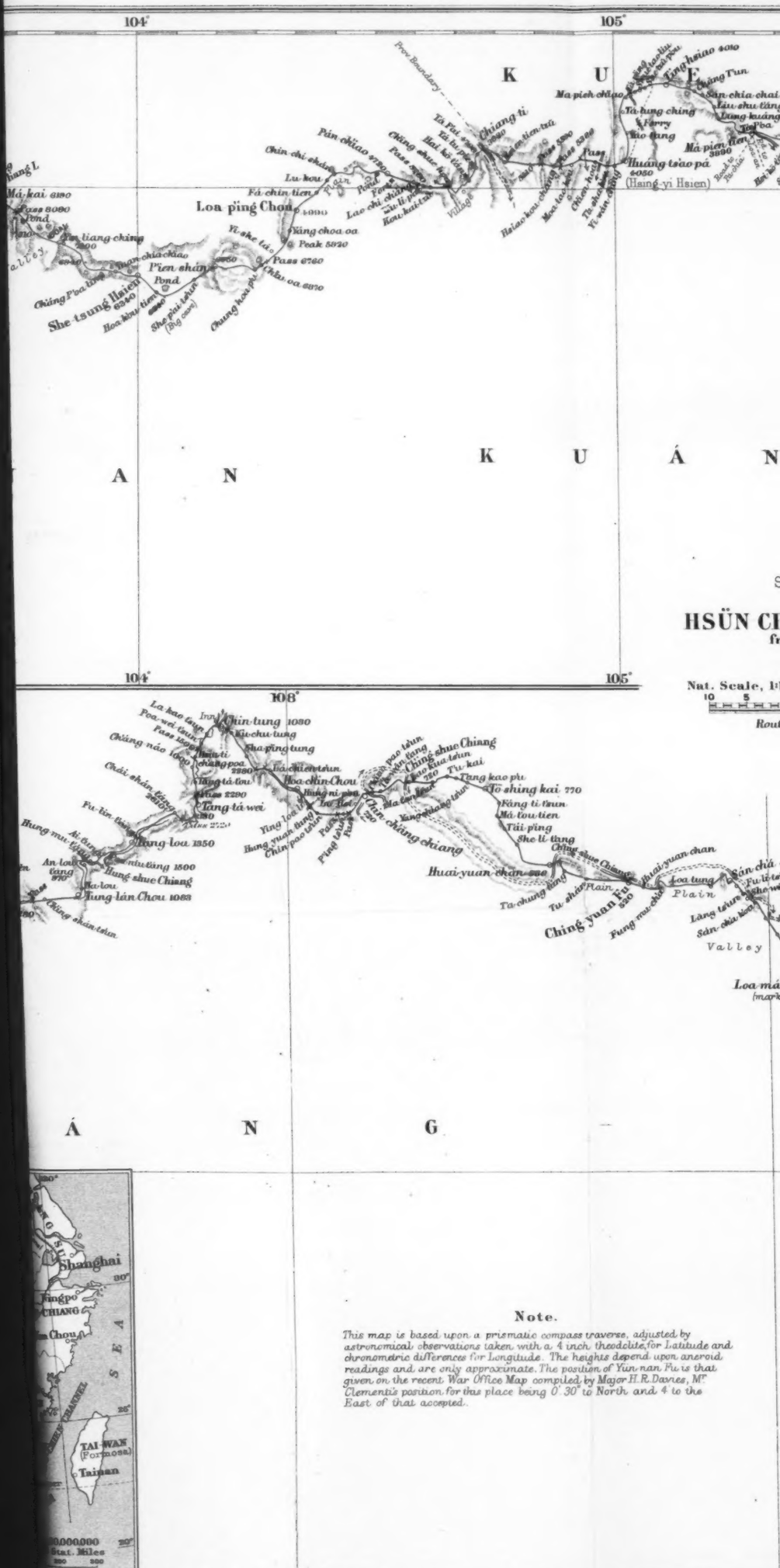
Place.	N. Latitude.			E. Longitude		
	°	′	″	°	′	″
Yün-nan Fu (Davies)	25	2	30	102	41	0
Yün-nan Fu (Clementi)	25	3	0	102	45	0
Má-kai	24	58	14	103	43	35
She-tsung Hsien ...	24	50	27	103	59	47
P'ien-shán	24	51	7	104	9	53
Loa-p'ing Chou ...	24	57	54	104	20	11
Pán-ch'iao	25	1	40	104	31	27
Chiang-ti	25	4	27	104	43	44
Huáng-ts'ao-pá	25	3	17	105	1	30
Ting-hsiao	25	11	53	105	6	39
Má-pien-t'ien	25	6	15	105	17	16
Hsing-yi Fu	25	6	59	105	31	10
P'oa-chiao	24	56	6	105	31	28
Pán-pá	24	49	40	105	34	22
Pán-fáng	24	48	47	105	47	5
Hsi-lung-chiao Chou ...	24	40	40	105	50	23
Pán-t'ao-chán	24	30	50	106	4	47
Lu-ch'áng-ssu	24	24	4	106	11	6
Loa-li	24	15	59	106	18	54
Wáng-tien	24	6	53	106	25	4
Ssŭ-ch'áng Fu	24	20	25	106	40	14
Pien-ts'un	24	19	26	106	48	52
Loa-lou	24	24	29	107	0	54
Máo-ai	24	25	36	107	4	29
Shō-kang	24	23	0	107	13	30
Fung-shán Chou ...	24	33	17	107	13	30
Ts'án-li	24	38	25	107	18	39
P'oa-wang	24	30	5	107	25	32
Tung-lán Chou ...	24	31	14	107	33	35
T'ung-loa	24	37	12	107	40	20
T'áng-tá-wei	24	41	39	107	48	4
Chin-tung	24	50	35	107	51	27
Hoa-ch'in Chou ...	24	43	19	108	1	21
Chin-ch'áng-chiang ...	24	42	48	108	9	54
Tō-shing-kai	24	43	3	108	24	44
Huai-yuan-chán ...	24	34	49	108	32	58
Ching-yuan Fu ...	24	32	54	101	42	5
Sán-ch'á	24	32	54	108	55	10
Loa-mán	24	21	54	109	2	54
Lán-chou Fu	24	17	0	109	12	56
Ch'uán-shán	24	3	21	109	13	49
Hsien-chou Fu ...	23	19	33	109	51	20

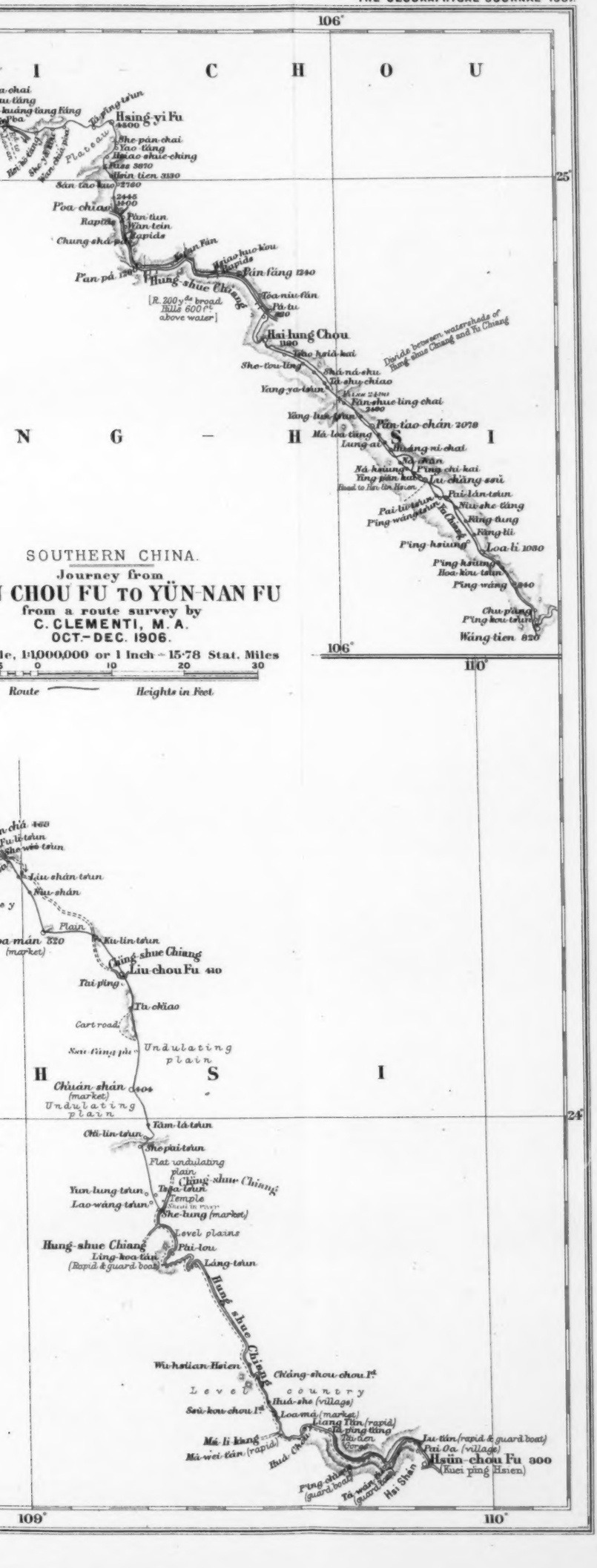



103°
104°
Lu-liang Chou
Yi-liang Hsien 8310
Ma-kai 6190
Loa-p'ing
Yang-tsung-li 5600
Pa-ta-hoa
Tien-shang-kuan 6720
Pass 6090
Pond
Valley
Plain
Temple
Beacon 6850
Pien-shan
Pond
She-tsung Hsien 6340
Ü N — N A N
103°
104°


107°
Ts'an-li 2180
Kou-chia 1850
Pass
River underground here
Fang-shan Chou 1500
Pa-wang 2280
Lung-loa 1350
Tung-lan Chou 1083
Ma-tung
Lung-tung P. 2090
Lodge 2090
Pass 2460
Liang-han
Shê-kang 1890
Ssŭ-Chang Fu 1890
Hsia-man-kuan
Hsia-mang-tsun
Shang-mang-tsun
Pass 2820
Mao-li 2020
Pien-tsun 2400
Pass 2750
Wall
Pa-shue-pa
Pass 2720
Pien-chan
Pass 2220
Pien-tsun 820
K U Á N
107°


KAN-SU
SHEN-HSI
HO-NAN
HU-PEI
AN-HUI
Nan-king
Shanghai
Hankow
Ichang
Wu-chang
Chêng-tu Fu
S S Ŭ - C H U A N
Ningpo
CHE-CHIANG
Chang-sha
HU-NAN
KIANG-HSI
Nan-chang
Wen-Chou
KUEI-CHOU
Fu-Chou
FU-CHIEN
Kuei-lin
KUANG-HSI
Canton
Swatow
Amoy
TAI-WAN (Formosa)
Tainan
Tropic of Cancer
Hongkong
Macao
Hanoi
TONG-KING
Gulf of Tong-king
HAINAN
Nat. Scale 1:20000000
or 1 inch = 316 Stat. Miles
0 100 200 300
CHINA SEA


104°
105°
K U E
Ma pien chi ao
Ta tung ching
Ferry
Tao tang
Ma pien tien
3090
Huang tsao pa
4050
(Hsing-yi Hsien)
Ting hsiao 4010
Chang Tun
Pan chiao
Chin chi shan
Lu kou
Fa chin tien
Loa ping Chou
4090
Yi she tai
Yang choa oa
Peak 5920
Pass 6760
Chou oa 4010
Ma kai 6180
Pass 8090
Pond
Tien liang ching
2300
Chang Poa tien
P'ien shan
Pond
She tsung Hsien
6340
Boa kou tien
She pai tsao
(Big cave)
Chang kou pa
Chiang ti
Pass 5290
Hsiao kou chang
Pass 5260
Chiao hou
Yi wan chang
Pass
Village
Plain
Pond
Pass
Valley
K U Á N
A N
HSÜN CH
fr
Nat. Scale, 1
10 5
Rout
104°
105°
108°
Chin tung 1090
Kiu chu tung
Sha ping tung
Chang pao
Chang nao tien
Chái chán tien
Tang tá tou
Tang tá wei
Fu lin tien
Hung mu tien
Ai tung
An lou tang
970
Tung lou 1350
Hung miu tang 1500
Hung shue Chiang
Ma tou
Tung lán Chou 1083
Chang shan tsun
Hua chin Chou
Hung ni pien
Lao Hei
Ma tou
Ying lou
Hung yuan tang
Chin pao tsun
Ping tsun
Pass
220
Chin chang chiang
Yang chiang tsun
Huai yuan chan 2120
Ta chang ping
Tu shan
Plain
Ching yuan Fu
2320
Fung mai chi
Ching shue Chiang
Huai yuan chan
Loa tung
Plain
Lang tsun
Sán chia kou
Valley
Loa má
(mark
Inn
Pass 1500
Pass 2280
Pass 2290
Pass 2720
Pass 2120
Pass 2320
Pass 2220
Pass 2320
Pass 2320
Pass 2320


106°
I C H O U
Hsing-yi Fu 4500
Plateau
Hung-shue Chiang
[R. 200 yds broad. Hills 600 ft. above water]
Hai lung Chou 1180
Pán-tao-chán 2078
Loa-li 1030
Ping-wang 2440
Wáng-tien 820
25°
106°
110°
N G — H S I
SOUTHERN CHINA.
Journey from
CHOU FU TO YÜN-NAN FU
from a route survey by
C. CLEMENTI, M. A.
OCT.–DEC. 1906.
Route
Heights in Feet
Liu-chou Fu 410
Chuán-shán 1404
(market)
Undulating plain
Hung-shue Chiang
Level country
Wu-hsüan Hsien
Hsün-chou Fu 300
(Kuei ping Hsien)
24°
109°
110°